POPULAR SCIENCE

FOUNDED MONTHLY 1872

JULY • 1931

25 CENTS

HOUSE ON WHEELS HAS ALL HOME COMFORTS
Page 64

"I've followed the 'Big Top'

—says Chesterfield

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Children or grown-ups, we swallow the circus whole—and like it. But ballyhoo has no place in cigarette choice. What counts in a cigarette is how it *tastes.* And that's first a matter of how good the tobaccos are. Chesterfield uses tobaccos of better quality—nothing else—and blends and "cross-blends" them to give you *more* taste, *more* aroma. And greater mildness too!

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THE FAMILIAR TELEPHONE that stands upon your desk at the office or in your home is only a very small part of the great communication system that enables you to talk across the miles with such surprising ease.

Behind it are complicated exchanges, a carefully trained organization of more than four hundred thousand men and women and eighty million miles of wire. These are the forces that make efficient telephone service possible. These are the unseen couriers of the spoken word.

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POPULAR SCIENCE
MONTHLY

381 Fourth Avenue
New York, N. Y.

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July 1931, Vol. 119, No. 1. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1931, by the Popular Science Publishing Co., Inc. Single copy, 25 cents. Nine months' subscription, $2. Yearly subscriptions to United States, its possessions, and Canada, $2.50; foreign countries, $3. The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. In presenting numerous stories of the new products of science, **Popular Science Monthly** does not underwrite the business of the individuals or concerns producing them. The use of Popular articles for stock-selling schemes is never authorized.
Treasurer; R. C. Wilson, Vice-President; T. Briggs, Secretary.

Popular Science Monthly for July, 1931

DOUBLE DIVIDENDS from Sunshine Preferred!

By LEON MEADOW, *Financial Editor*

AS I SIT here writing, with the sun streaming through my office window, my thoughts go far beyond the realms of finance, stocks, or bonds.

Month after month—to the best of my ability—I've discussed trends and developments in the financial world. Month after month, I've recommended certain investments and soft pedaled others. Under normal conditions, my job's no harder than the next man's. But these last few months have seen no let-up in the so-called depression; have seen the stock and bond markets continue to sink steadily. So it's become increasingly harder to advise people with any degree of wisdom or surety.

Yet, there is one good investment every man can make with profit, and never at a more opportune time than this, especially for those to whom constant watching of financial trends has brought nothing but growing doubts and worries. This is one investment that never passed a dividend, and the more I think of it, the more I like it.

Outside, it's a day in a thousand, and I'm praying hard for the good weather to continue. For, in thinking of the investment I just mentioned, I also think of tomorrow—when I start tuning up the old gasoline chariot instead of thumbing the pages of some long-winded market report. Vacation time is here again! Tomorrow I hit the trail north to my old shack in the Adirondacks.

Of course, a financial editor is just as human as his next-door neighbor. And take it from me—his thoughts aren't always on stocks and bonds, or reports and statistics. Right now, the rippling of a certain trout brook upstate is sweeter to his ears than the clicking of ticker tape. And he's human on the job too—because his work demands that quality. He's got to advise people, tell them how to invest their funds and when to do it. Therefore his own problems are much the same as the man with $1,000 to invest or already invested—and the man with $1,000,000. He's got to find the solution just as they do.

BUT now that normal values and all the sane indications he used to watch for are disappearing further from sight each day, the guess of the man on the street is worth almost as much as the financial editor's. In short, this now famous depression of ours has given us all an unbalanced mental attitude. It has preyed upon us all for so long that few seem to have retained a clear view of conditions, and few approach investment problems in their true perspectives.

In my opinion, the man who wants to make an investment right now had best forget the market for the present and turn to something of more immediate importance, something that can directly and indirectly lead to greater profits for him. In any case, he ought not let his confidence and firm belief in the basic and ultimate soundness of America's industries, properties and manpower be undermined even temporarily by a set of harrassed nerves. The best thing he can do is to follow my own plan—an investment I'm so sold on. I'm buying some of it tomorrow when I start on my vacation. Take the advice of a financial editor who has realized what a vacation may mean in terms of abounding health and a return to calm, clear, normal thinking. Tune in on some fresh air, sunshine, change of scenery, and good health . . . preferred or common!

I was never more serious in my whole life. Take your two weeks—as I'm taking mine—and go off some place where your mind won't be called upon to do more than direct your muscles in fourteen days of play. Take it in hunting, fishing, camping, sports, traveling—or in all of them. Build yourself a log cabin like the one described further on in this issue—buy yourself a bit of ground off some place in the woods. Then you're all set to weather out any depression, to come back to your job and to your investment problems in a new and better frame of mind. You can do it with a tent and a frying pan, with a car or an outboard racer, with a canoe or a rowboat. You can do it with any change that frees your mind from worries and doubts—and lets you clip those good health coupons we all can use!

AGAIN I repeat that today, in the world of finance, your guess is as good as the next man's. There still is an oversupply of information, facts, and figures. And when you get through absorbing it all, a toss of the coin is almost as good a way as any to decide whether you've been wise or not; whether you're going to make money or lose it. But there are no two ways about a vacation. No two ways about the outcome of investing in sunshine and sport, in health and energy, in freedom from worries, in renewed mental balance. It must prove profitable.

The benefits are double. While you're away, you'll be storing up health and ease of mind—and in a world that measures so many values by the almighty dollar, these have become nonfinancial investments that are invaluable. The time comes when even money can't buy good health bonds—and never has there been a better time to start accumulating them than now. And while you're away, you'll forget that such things as the stock market ever existed—which, to a lot of us, would be a godsend in itself! The second benefit comes when you return, refreshed and clear-minded. Because then you'll realize again that this country is a firm place, with ground under your feet and sky above. That people are still working, railroads running, steamers in service, factory smoke rising, and offices still open. In other words you'll come back—as I will—clear-headed enough to see that this country is still alive and kicking—and still traveling forward. Time enough then to start thinking about investment problems, and to face them in a logical and sane-minded fashion, free from the widespread ailment that has come as a result of being "depression-minded."

Day after tomorrow, I'll be out in front of that shack of mine up in the mountains. I'll be puffing away at the old pipe, inhaling its fragrance, made sweeter still by the heavenly odor of brook trout rolled in bacon and broiled over a crackling fire. Then I start clipping coupons on a real investment. I'll be back on the *(Continued on page 5)*

DOUBLE DIVIDENDS FROM SUNSHINE PREFERRED!

(Continued from page 4)

job soon, seeing things in a saner light, viewing the whole situation from a fresh, unbiased point of view. And it's my conviction that if you follow this advice, you'll agree with me when you come back, that sunshine preferred pays double dividends. You'll agree that it was more than worth while to temporarily put aside worries about immediate financial problems and to devote your two weeks to laying in a stock of health and clear-headedness. That it was more than worth while to build up a sufficient share of energy and vitality, so that when you do get back, you'll have enough to take care of your job and your problems—and still be able to do enough straight thinking to get a firm, clear picture of your investment questions. Remember—there never was a better time to clip sane-judgment and clear-thinking coupons; never was a better way to put you on the right track toward making investments that will give you dollar and cents coupons to clip later on.

Do you check with me on these thoughts? I'm downright curious to know what you think of this advice—and whether you consider my plan a solution to these problems as well as a splendid investment in itself.

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"The Provident Provider" is a booklet describing a new savings plan which provides a regular retirement income for a man and insurance protection for his family. A copy will be mailed on request by Provident Mutual Life Insurance Company, Philadelphia, Pennsylvania.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

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Guaranteed Advertisements

Popular Science GUARANTEE

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use.

Tools, Radio Apparatus, Oil Burners and Refrigerators advertised in POPULAR SCIENCE MONTHLY have been tested or investigated by the Popular Science Institute of Standards and each advertisement carries the insignia indicating approval.

However, other products advertised in the magazine not subject to test carry the same guarantee to readers as products tested.

THE PUBLISHERS

Keep Your Copies of "POPULAR SCIENCE" In This Beautiful New Binder

There is so much useful information in Popular Science Monthly that many readers have asked us to supply them with a binder in which they can keep a permanent file.

To meet this demand we have had designed the binder pictured above. Bound in deeply embossed Artcraft (looks like leather—lasts forever) with the name of the magazine and cameo design stamped in 24 Karat Gold on the cover. This binder will securely hold 6 copies of Popular Science Monthly.

New copies can be slipped into the Big-6 Binder as easy as inserting a letter in an envelope.

There is nothing to get out of order—no screws to work loose, no keys to get lost. This binder will last a lifetime.

The binder is as beautiful as it is useful—it will be an ornament to any library table.

Only $2.00--Postage Prepaid

Bought in a store this binder would cost you $3.00 or more. Because we are having them made in quantity for our readers we can make you the special price of $2.00 including all delivery charges.

Popular Science Monthly, 381 Fourth Avenue, New York, N. Y.

Please send me your Big-6 Binder bound in deeply embossed Artcraft with "Popular Science Monthly" richly embossed on the cover in 24 Karat Gold. I am enclosing $2.00 and it is understood that there is to be no further charge of any kind. [7-31]

Name.....

Address.....

.....

Advice from Experts Is Usually Safe

Listening to a salesman very frequently proves confusing to the prospective buyer.

NOW is a good time to spend money—carefully; none of us is doing much indiscriminate buying these days with the idea of "learning as we go" and perhaps making a second, wiser purchase at some later time. However, there are many cases when it is none too easy to make a selection and be sure of choosing rightly.

This is where Popular Science Institute aims to fill the breach. It has made a careful investigation practically of all the nationally sold products in the three classifications of equipment in which POPULAR SCIENCE MONTHLY readers have shown most interest and most frequently sought help in buying. So, now, in the three fields of tools, radio equipment, and oil burners, there is reliable advice to be had from the Institute.

Any buying advice given out by Popular Science Institute may be depended upon as authoritative, for in every case our tests and investigations are thorough and accurate. Rather than roughly cover a large scope including many kinds of products, it was felt that the Institute should concentrate on this smaller field and spare no effort or expense in getting all the data necessary on which to base its opinions and recommendations of equipment.

This policy has been carefully adhered to ever since the Popular Science Institute was established in 1924. In the first place, the men selected for the staff of this organization were expert in their particular fields and were used to making tests of the most extensive and accurate nature.

The Director of the Institute is Professor Collins P. Bliss, who is Dean of the College of Engineering at New York University, and director of the testing laboratories of that institution. Under him is a group of university professors who give a certain part of their time to the Popular Science Institute testing work.

THE tests that have been formulated and the standards established have all been worked out under the personal direction of Dean Bliss and, before any action is taken regarding a product under investigation, he goes over all test data and determines whether the product deserves the approval of the Popular Science Institute.

Some products go through the hands of several test engineers before they are ready to be passed upon. For instance, in the case of tools, the hardness of the metal will be tested by a particular expert in that line, while other engineers will be in charge of the various other stages of test.

Tests of this sort frequently call for rather elaborate testing equipment and Popular Science Institute is fortunate in having its tests conducted in the well-equipped Sage Research Laboratory at New York University. Here, more than $300,000 worth of testing equipment is available in making Institute tests.

In connection with this matter of test apparatus, many people are surprised to learn that it is often not possible to buy ready-made equipment in working out tests of a new nature and it has meant that special apparatus had to be devised by the Institute's engineers. Some of the arrangements they have worked out are very ingenious and have evoked considerable comment from visiting engineers.

REPRESENTATIVES of the U. S. Bureau of Standards have visited the laboratory on several occasions and witnessed the tests in progress. In 1928, Dean Bliss, the Institute's Director, was made consulting engineer for that government bureau. Through this affiliation, Popular Science Institute has been able to be of some service to the Federal Specifications Board, on a few occasions making special tests that provided data in drawing up specifications for certain kinds of hand tools.

While the Popular Science Institute has pioneered in many types of radio and tool tests, it did not deem it advisable to investigate oil burners by the laboratory test method. Since an oil burner is not a unit in itself but part of a heating system, it is not possible to get practical information by merely testing it by itself. The most feasible plan, the Institute decided, was to find out how a burner would perform in a hundred or more different installations in conjunction with all sorts of heating systems and under all sorts of conditions.

So a nation-wide survey of oil heating installations was undertaken. Investigators were sent into 1,500 homes where there were oil burners installed, and 1,500 other owners of oil heating devices were questioned by mail. The combined tabulated results presented a clear picture of the degree of satisfaction various makes of oil burners were giving.

All recommendations of products by Popular Science Institute—whether tools, radio equipment or oil burners—are based on first-hand and thoroughly comprehensive information secured either through laboratory test or specially conducted investigation. Furthermore, these recommendations are unbiased, definite facts and figures being the basis of judgment rather than personal opinion.

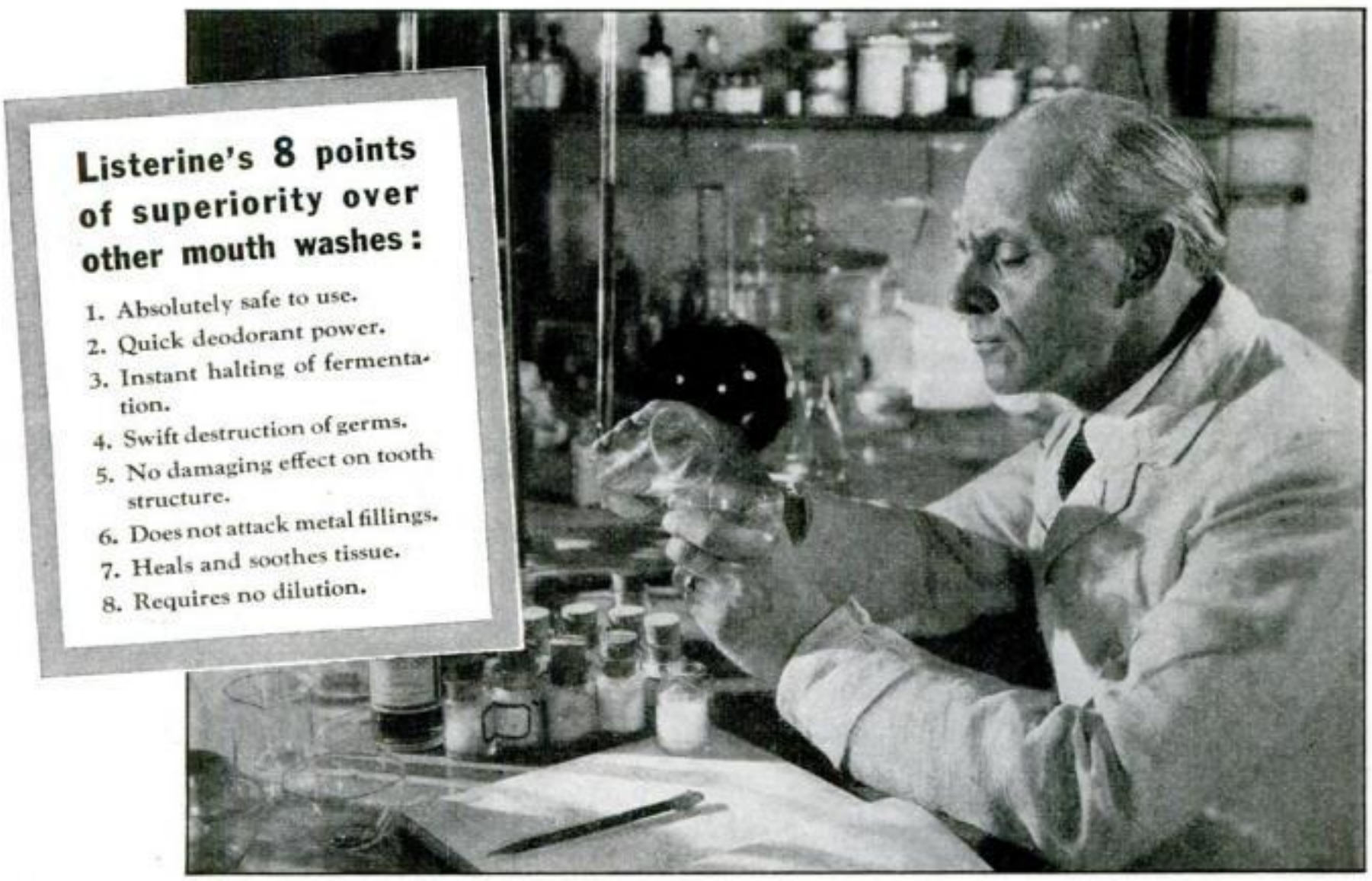
INSTITUTE BULLETINS

Heating and Ventilating*
Insulation in Building Construction*
List of Approved Tools
List of Approved Radio Sets
List of Approved Oil Burners
Advice on Installing Oil Heat
Refrigeration for the Home*

*Starred bulletins 25 cents

Another triumph for Listerine!

Instantly overcomes odors other antiseptics fail to mask in 4 days



Always the safest of antiseptics . . . now the swiftest of deodorants

The most searching scientific analysis ever made on the subject of deodorant power of mouth washes now reveals Listerine, the safe antiseptic, as the outstanding deodorant for oral use.

Repeated tests show that Listerine immediately overcomes odors that other solutions fail to mask in 4 days.

Because of its amazing deodorant effect, its power to kill germs in the fastest time, and its absolute safety, Listerine is the ideal antiseptic for oral hygiene.

For the treatment of halitosis (unpleasant breath) there is nothing like it. 95% of halitosis is caused, dental authorities say, by fermenting food particles in the mouth and by infections of the oral tract.

Listerine instantly halts fermentation, and at the same time attacks infection. Having struck at these two causes of mouth odors, it then overcomes the odors themselves.

Use it every morning, every night. And between times before meeting others. It is your assurance that your breath will be sweet, clean, and wholesome, and therefore inoffensive.

Keep Listerine handy in home and office. Carry it with you when you travel. No other antiseptic mouth wash is so pleasant-tasting. No other mouth wash has swifter deodorant and germicidal effect. No other mouth wash is more healing. Lambert Pharmacal Co., St. Louis, Mo., U. S. A.

LISTERINE ends halitosis (UNPLEASANT BREATH)

Our Readers Say

That Spring Fever Bug'll Get You!

EVERY spring, about ninety percent of the people seem to go on a slow-motion strike. And it is all due to the spring fever bug. Why doesn't science do something about it? Right now, I will bet, the number of those pining away from this pestiferous plague is so great that if they stood on each other's shoulders, the top one could kiss the Man in the Moon. If somebody could sock this microbe right on the antennae, that *would* be an achievement! We know all about vitamines, calories, ultra-violet rays, and other remarkable discoveries. We have conquered plagues and virulent diseases. But, as far as I know, we haven't found anything better for spring fever than the old sulphur and molasses mother used to feed me in 1890. If any reader has found a good way of escaping the spring fever bug, let him write in to the Editor so his remedy can be printed. All of us, who join the Lazy Legion each spring, will thank him.—R. R. S., St. Louis, Mo.

More Articles Like This on the Way

IN A RECENT issue of your magazine there is an article entitled "Why Can't Men Become Giants or Jump Like Grasshoppers?" This is an interesting article, because it explains a simple rule that few people understand. I think that it would be a good idea to publish articles like this frequently. Take any textbook on elementary physics, and explain any one of the laws expounded there and then list practical applications of this rule. Remember few people have gone through high school and have learned of these things.—W. B., North Wales, Pa.

You Auto Racers, Let's Get Together

I AM glad that someone has at last mentioned auto racing, and I only hope that G. P. A. is interested in the same type of racing that I am. To me the sport of auto racing is to build your own racer and put it on the track. Don't think by this that I mean to build a car costing a small fortune, because that's entirely out of my line, but I believe that I can prove that a model T Ford is the best car from which to build a racer, providing you do not wish to travel over eighty or eighty-five miles per hour. One of the big advantages of a model T is that you are able to buy almost anything for one secondhand. I also believe that there are many POPULAR SCIENCE MONTHLY readers who would like to get some new ideas on how to increase the speed of a model T Ford or how to lower the frame seven or eight inches. All those who are interested please write in and we will try to boost auto racing.—P. H. L., Loveland, Ohio.

American People Careless of Life

YOUR editorial "Stop the Fool Drivers" is timely. Keep up the good work. It would be interesting to know the number of passengers carried last year by our railroads and the number of accidents. Probably we could not estimate the number of persons that traveled in autos so no percentage of accidents could be arrived at. But the American people must be careless of life when so many travel the narrow hard roads at speed of sixty miles per hour and over, without a block signal system and other safeguards.—H. L. I., Springfield, Ill.

Now You Can Tell A Moron on Sight

YOUR "Let's All Be Morons" insinuates that the definition of moron may not be correct. The Book of Popular Science raises the same question when, in discussing genius, it points out the fact that genius is conditioned on the survival of "child intelligence" far into mature life. If this is true then what is the moron? My definition of the moron, based on nearly forty years study and experimental work in psychology, is that the moron is a person who has lost the practical use of his or her primary intelligence through the power of some false or narrow theory or view of life to paralyze intelligence. My observations led me to believe that, thirty years ago, most children retained the free use of their intelligence up to about twelve years of age when theories and habits of thought and action began to take the place of their intelligence, and in many cases almost completely did away with the use of such intelligence. In one case that I personally investigated, and am personally acquainted with, a stubborn fit turned an intelligent twelve-year-old boy into practically an idiot who is now about forty years old. By intelligence we have reference to those pre-experimental elements of mind that make intelligent experience and thought possible and are known as common sense.—J. W. M., Trenton, Mo.

He Likes Us but Has His Own Ideas

I NOTE from the present issue of POPULAR SCIENCE MONTHLY that you are preparing to publish some articles on the origin of man. I suppose this will consist of the usual lot of nonsense and imagination from these so-called scientists, who really know nothing about the subject, but as you advertise these gentlemen are going to *prove* this I shall be greatly interested. I noted a short time ago that one of these gentry said the world is sixty-five million years old. What I cannot understand is, why he did not say sixty-six millions. Then I saw where another learned gentleman was going to tell the world's age by counting the flakes or some such darn thing. However POPULAR SCIENCE MONTHLY is really a fine magazine and very very interesting.—W. G. W., Port Arthur, Ont.

Photography Wins His Loudest Cheers

I WAS very much pleased to notice in a recent issue of POPULAR SCIENCE MONTHLY the increasing amount of space you are giving to photography. I was especially delighted with the announcement of a series of articles to be published under the general heading, "How to Take Better Photographs." That's fine! I'm sure that among your army of readers are many amateur photographers, like myself, who will welcome this promised series and read it with great interest.—A. K., Jamestown, N. Y.

Did That Meteor Strike the Ford?

IN A RECENT issue of your periodical is an illustrated article in regard to a meteor striking the hood of a Ford automobile. When I read the article I knew that it was not true, or the illustrator was in error, as meteors that strike the earth descend in a vertical direction.

I did not refer again to the article until I read elsewhere a long article by a member of the Meteor society. Then I reread the article in your magazine. Why, in a magazine like POPULAR SCIENCE MONTHLY do you publish such stuff? A little thought would have convinced you that it was wrong somewhere. Even though the illustrator did not know that meteors fall perpendicularly, the puncture in the hood and radiator would brand it as untrue.—L. St. J. H., Richmond, Calif.

A Mighty Sock Is Good for Our Soul

I HAVE just finished reading your second article on Russia, entitled, "Soviet Slaves Rebuild Red Russia." I must say that I was very much disappointed with it. I read your first article and it was fairly good; in fact I passed it on to several of my friends, and I was looking forward to a series of these articles on communism, which in my opinion is the one great issue before the world today. The photos in your second article are good but title and text are, without doubt, the most misleading piffle it has ever been my misfortune to read. If Michel Mok wants some authentic material for future articles he can obtain a good picture of the situation from the files of the *New York Times*. Please don't print any more stories

like the one ending, "Who ever heard of anybody wearing shoes in Paradise?" Such stories don't make good sense and I hope this is the last you ever print.—P. D., Claypool, Ariz.

Your Artist's Picture of the First Man

HAVE just this minute finished reading the first article in your magazine about How Man Was Created. You certainly carry that happy event back to a far-away point in time. Any way, no one can contradict you because almost nobody is alive now who was there to see the first man stand up and look about him. So your version is as good as any other and I don't see how one could be foolish enough to quarrel about it. However, the main reason for writing this letter was to suggest that it would be a good idea if the artist for "Our Readers Say" were to draw us a picture of how he thinks the first man looked. I'd like to pin it up on my wall just to take the conceit out of me, when I get swelled up over what the Little Woman has been saying to me.

Other people might like it for the same reason—or maybe they wouldn't. But at any rate I think it would be a fine idea because after all these ancestors are a long long way behind us and there is no need now to be ashamed of them.—A. H., New York, N. Y.

Here's the Age of the Blushing Bride

IN REPLY to C. C. W., Wichita, Kan., who has a problem in May POPULAR SCIENCE MONTHLY reading: A man is now twice as old as his wife was when he was as old as she is now. When she becomes as old as he is now, the sum of their ages will equal one hundred. If the problem is stated correctly the wife's present age is twenty and the man's forty. When she is forty, he will be sixty, and the sum of their ages will equal one hundred. Q. E. D., what?—H. N., Lodi, N. J.

Endless Lessons in Science Requested

I WAS interested in the suggestion put forth by C. S. M., Detroit, in a recent issue. The suggestion was that POPULAR SCIENCE MONTHLY should publish a series of lessons in science. Being a layman in the scientific field, this idea appeals to me as capital. I do not, however, quite agree with C. S. M. in his apparent motive. The motive, as I understand it, would be to educate the readers of POPULAR SCIENCE MONTHLY into an understanding of a purely technical magazine. In that case it would be waste of time for me to recommend the magazine to lay friends. Upon examining the publication they would decide that they did not know what it was all about. I strongly support C. S. M.'s idea, but would change his motive. I would suggest that after completion of the series, more technical articles should be published, but considerable space should be given to simpler treatises. Further I suggest that the series of lessons be tabulated by date of issue and article number. By this means references could be inserted into future articles.—W. R., Winnipeg, Can.

Put Your Airplane in Definite Latitude

IN ANSWER to R. E. H., of Elyria, Ohio: If two airplanes start at sunrise, one going east and the other west, both flying at one hundred miles an hour, the length of each one's day would depend on the latitude of their starting point. At the equator, the eastbound plane would have a day of twenty-one hours forty-nine minutes, and the westbound twenty-six hours forty minutes. But the higher the latitude, the shorter would be the day of the eastbound plane, and the longer the day for the other. So you see it all depends where on earth you are.—F. P. M., Montreal, Can.

His Own Idea to a Perfect "T"

B. K. of Philadelphia has voiced my desires exactly. A series of articles on the construction and lighting of a miniature theater would be intensely interesting, not only to your readers who are interested in the theater but to all model builders as well.—D. W. S., Dayton, Ohio.

Delighted with Radio That Cost $4.95

I HAVE been a constant reader of your magazine for six years. I have only the highest praise for this publication and enjoy the articles on aviation, automobiles, hints for mechanics, Gus says (this is a really helpful article to any auto owner), radio articles, and models. I recently built the three-tube receiver, the plans for which were in the April issue. This set is certainly a wonder. It has absolutely no hum, although the filter circuit is simple and a 227 type tube is used for a rectifier. The little set has ten-kilocycle separation on a good many stations, and although we have a powerful local station close by it only spreads over four degrees on the dial. I have received Dallas, Montreal, Shenandoah, Iowa, Chicago, New York, and nearly all intermediate stations. I have logged forty-three in two weeks' time. I receive WLW, WEAF, WBT, and WHAS on loudspeaker with good volume. The volume on all stations so far logged is uncomfortable with headphones with maximum adjustment of the dials. I bought all the parts for this set including tubes for $4.95. I wound my own coils.—E. P. M., Charlotte, N. C.

Here's the How of Floating Corks

THIS ought to set P. D. B., Vancouver, Can., on the right track: The force that attracts the cork to the side of the vessel is known as "adhesion"—that is, the force of attraction between unlike molecules. The force that draws the two corks together is called "cohesion," the force of attraction of like molecules. Any high school physics book tells all about it.—E. S. D., Chicago, Ill.

Not the Only Book to Miss Montgomery

I NOTICED the comment of R. R., San Francisco, who says that John J. Montgomery should be considered the father of aviation. Where did he get his information? I merely point out to him a little book printed by The Oxford University Press and entitled, *"The Conquest of the Air—An Historical Survey"* by C. M. L. Brown. Quoting from this book, we find that the "first scientific student of flight" was Da Vinci, and "Otto Lilienthal was the first man to practice gliding persistently and scientifically. Among the many who contributed to the ultimate success of the aeroplane, he stands second in importance only to the Wright brothers."—W. H. McI., Scarsdale, N. Y.

Now His Wife Has a Big Advantage

I WILL open up my squawk by paraphrasing an old adage: Show me what you publish and I will show you what kind of an editor you are. Heretofore, I never did agree with what some of your readers imply in their criticism of some of the articles in your magazine. But henceforth I stand with your critics one hundred percent. This is not because of something you have published, at this writing, but because of what you say you are going to publish. It is bad enough for wives to call their husbands worms, insects, and poor fish without you coming forward with eighteen scientists to help them prove it!—R. A. L., Louisville, Ky.

Just Another View of Russian Articles

AS A constant reader of your interesting magazine for many years, I should like to express my appreciation over your splendid and unbiased articles on Russia. Because we see so many misleading articles in the daily papers regarding Russia, it is refreshing to read something written from the scientific point of view. I also enjoy your articles on aviation very much, and I hope you will deal further in the future with these two fields.—H. H., Winnipeg, Can.

Builds Model Racer That Looks the Part

I WAS quite interested in the plans for Sir Malcom Campbell's racer which you published recently. I might suggest that a friend of mine made one of these some time ago and used balsa wood in it. It was geared up and ran with rubber just as a model airplane. You'd be surprised at the resemblance it has to a real racer when it dashes down the road.

Every single issue of your magazine for the past four years has thoroughly satisfied me, and it certainly makes me tired to read the comments of those who want more of this and less of that. You can't please everybody, but you certainly do a fine job of pleasing most of us. And that, I suppose, is a record for any magazine to be proud of. Am I right?—W. C., Highland Park, Mich.

Just a Little Prohibition Problem

A MAN put half a gallon of water in a two-gallon can. He then went to a speakeasy and bought a gallon of rum. He asked credit for the liquor but of course that was out of the question, and the salesman at once took back his gallon of rum from the man's can which left half a gallon of rum and water in the can. The sharp buyer then visited two other speakeasies and played the same trick, having at the end half a gallon of water and rum left in his can. What percentage of this resulting mixture was rum? How much of a kick would it have?—F. C., O'Leary, Can.

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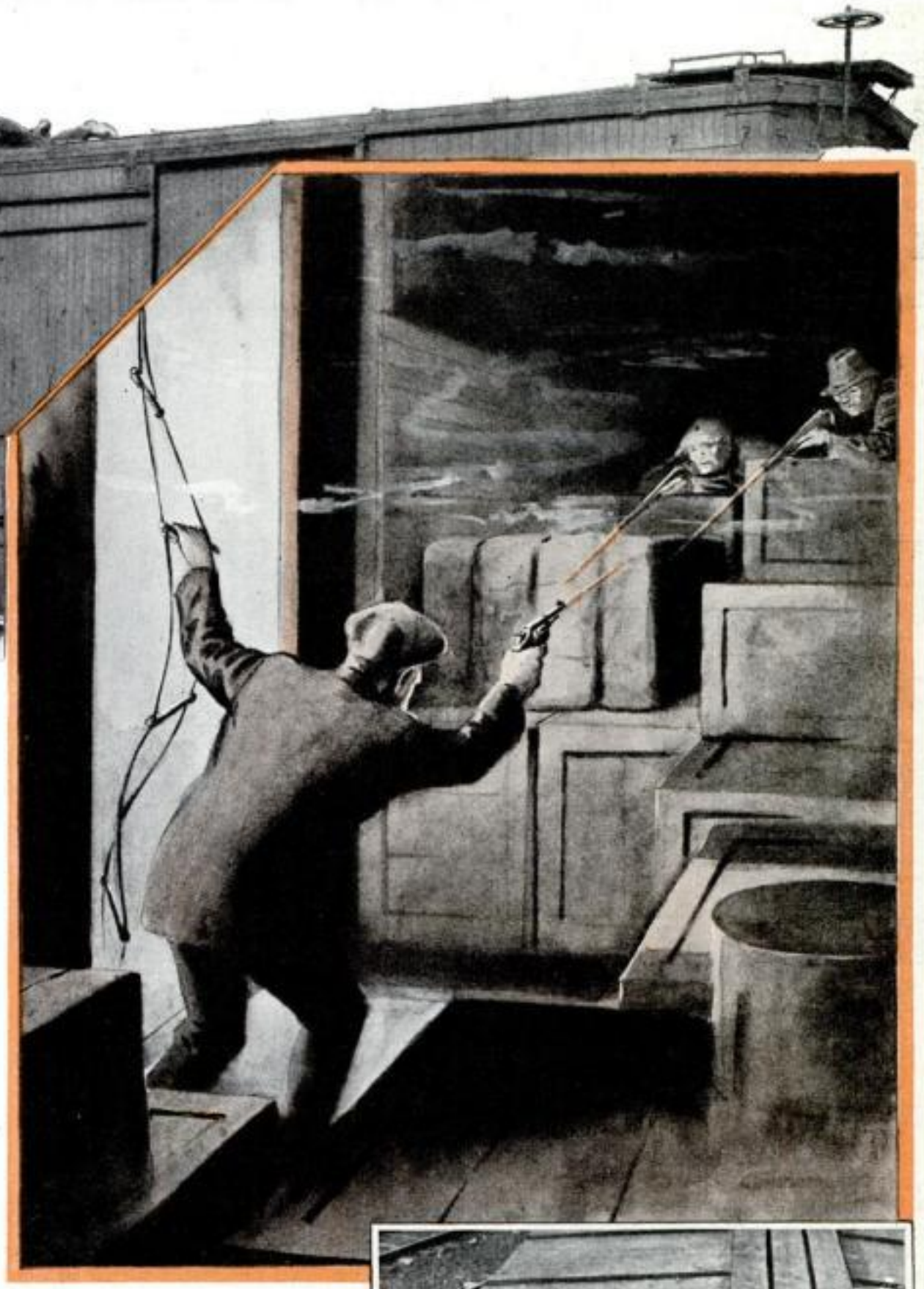
POPULAR SCIENCE MONTHLY

FOUNDED 1872 · SIXTIETH YEAR

July, 1931 · RAYMOND J. BROWN — *Editor* · Vol. 119 No. 1

Train Robbers Routed *by* Science *and* Brawn

ALL the world loves detective stories. Here is one that deals with real men and tells the thrilling truth about their fight to save millions of dollars in stolen goods. Ten years ago American railroads were losing $13,000,000 a year to box car bandits. On one road, scientific methods and the careful training of road police have now cut off about ninety-nine percent of this loss. In this story you see how these men do their work.



By BOYDEN SPARKES

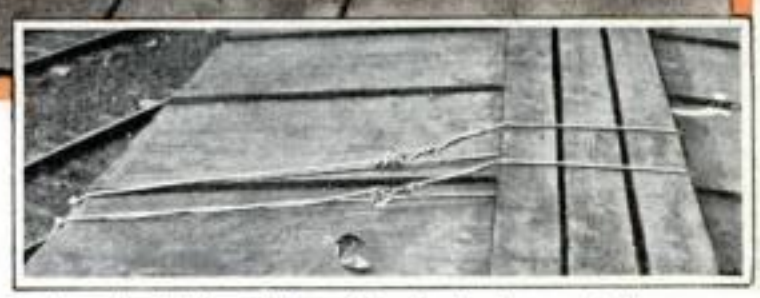
Chief James D. Roosa, head of N. Y. Central police in East.

I LIKE detective stories. Best of all I like stories of real detectives. Consequently when Professor Charles P. Berkey, Columbia University geologist, told me that a pile of rocks on his table was a clue in a mysterious robbery I pleaded for details.

"I'm just a helper on this job," said Professor Berkey. "The real detectives are members of the New York Central Railroad police force. I am not at liberty to tell you about this case, but if you see Carl Jellinghaus, the railroad's superintendent of Property Protection, perhaps you can get the whole story."

I did see Jellinghaus and I got the whole story of the rocks. Better still, I got other yarns that made my blood course faster than any tales ever told of scientific detectives of fiction.

To get the full measure of a great railroad system's fight with thieves it is necessary to consider the state of affairs that existed at the close of 1920. In that year robbers had taken from the trains and stations of the New York Central a total of $2,596,560. The Central was not the only road that was suffering from these bold criminals. For a long while conditions had been growing steadily worse until in 1920 the total loss by robbery on the rail-



A strip of blue light relieved the gloom of the car. The shooting began at once. It was by no means a one-sided battle. At top and above actual photographs show how rope ladder is used to enter moving car.

roads of the nation was $12,726,947. Last year the robbery loss of all the railroads was less than $1,000,000.

Affairs were in such a state that something had to be done. How well it was done on the New York Central may be shown by another total. Remember that the robbery loss in 1920 was $2,596,560, and then contrast with that the total loss for 1930, which was $27,936. When Jellinghaus gave me those figures he grinned. Then he wrote down another figure.

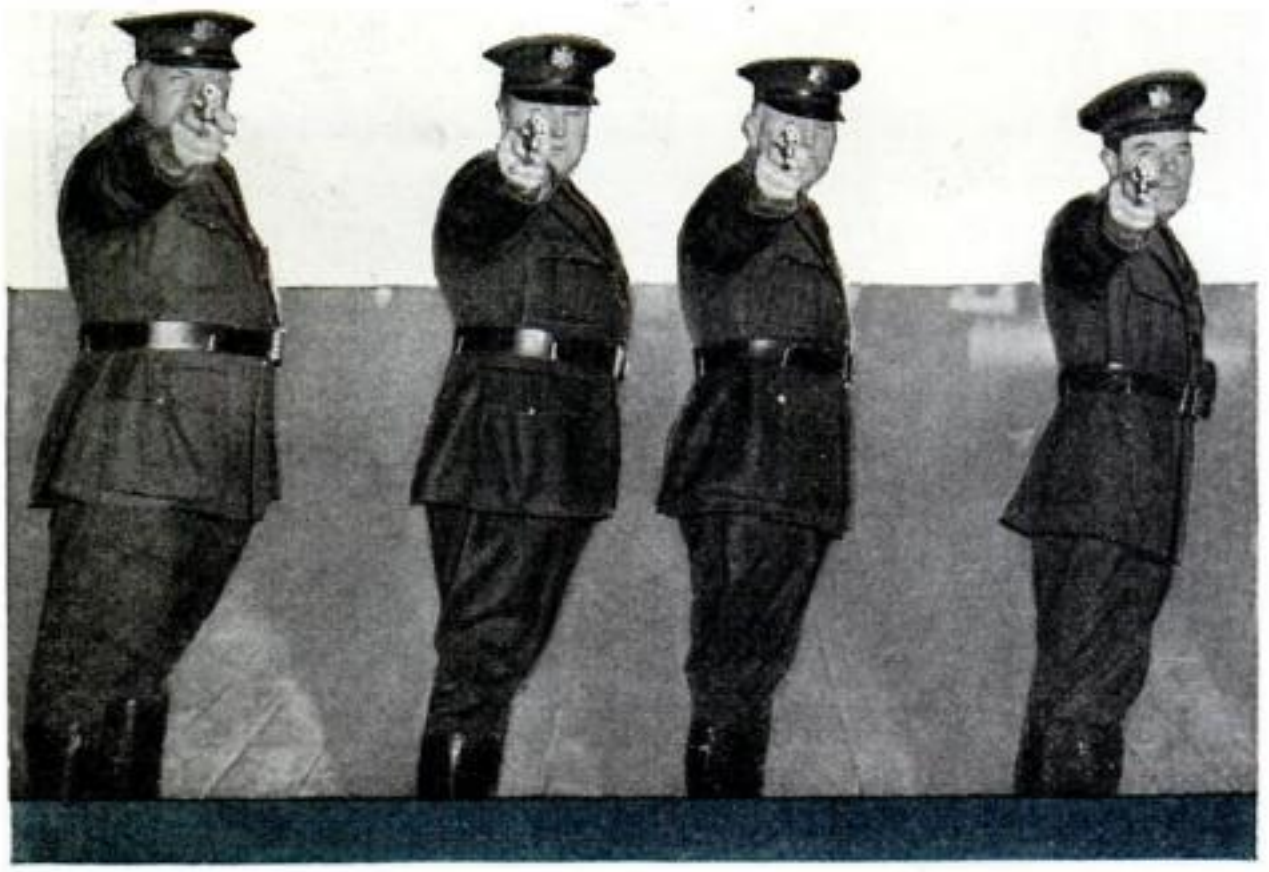
"This," he said, "is the proportion to which the robbery loss has been reduced in ten years."

I LOOKED at what he had written. The figure was 1.1 percent. That comes pretty close to being a perfect score.

"That change was not worked by keeping books," I said. "How was it done?"

"Well," he said, "some men were killed; some were wounded; a lot went to jail—car burglars, pickpockets, sneak thieves, crooks of all kinds. Our lines ten years ago were infested with thieves. Now it is different. Hoboes avoid our lines as carefully as they avoid work, and as for pickpockets, when one of them is seen around one of our stations he is pretty likely to keep his hands in his own pockets."

"But how?" I persisted. "How about those rocks and Professor Berkey?"



By constant practice on the target range, railroad detectives become expert shots and the skill they have acquired has been a big factor in cutting down the depredations of the box car bandits.

The answer to that was an interesting revelation of the growing use of scientific knowledge in detective work. The rocks I had seen on Professor Berkey's table had been found by an amazed grocer when he opened a packing case that was supposed to contain cheese from a Mediterranean port.

Other complaints began to pour in from other merchants who had found rocks in boxes supposed to contain cheese. If the substitution had occurred anywhere along the New York Central the railroad would be liable to the shipper for the full value of his cheese. Who could say where those rocks came from? Well, a geologist might, and consequently specimens were taken to Professor Berkey.

"This is lava," said the distinguished Columbia geologist. "It is a peculiar form of lava and I can guarantee that it came from just one place. Mt. Vesuvius."

THAT was one robbery about which the New York Central could cease to trouble itself. The ship that had carried a cargo of cheese across the ocean to New York had stopped en route at Naples. Obviously the substitution had occurred there. The railroad was not responsible.

The switching of rubbish for merchandise is a common trick of freight thieves. The motive is always the same—to delay discovery of the crime as long as possible; and, of course, an empty box would arouse the suspicion of the first person to handle it. Among railroad men this sort of thing is spoken of as a concealed loss.

Sometimes it happens that the rubbish exchanged for stolen goods leads the detectives unerringly to the thieves. Once a ship that had left the Amazon loaded with crude rubber was discovered, when preparations were made to unload her, to be partially filled with rocks. Where had the substitution occurred? The ship was tied up at a railroad pier, but in her log was written the record of a five-thousand-mile journey. Were the thieves in South America, the West Indies, New York, or aboard ship?

Specimens of the rock were submitted to Professor Berkey. He identified them as pieces of concrete, and the concrete had been made from Long Island sand. The trail was hot! A concrete pier was being demolished in the immediate vicinity of the ship's berth. That was bringing the crime pretty close to the men responsible.

OCCURRENCES of this sort illustrate a most important factor in the lowering of the robbery losses of the New York Central and other American railroads. The railroad police have learned how to localize crimes.

There had always been a force of railroad policemen, and some of the individuals were first-rate men. But there were not enough of them and they were not well organized. There had always been a simple way of telling approximately where the robbery had occurred, but it had not been used. Every freight car when loaded is sealed with a string of tin looped through staples on the sliding door and doorframe and fastened with a small ball of lead.

A CHILD might break that seal, but once broken no amount of ingenuity could disguise the fact that it had been tampered with. But what was the good of discovering, at the end of a freight car's journey, that it had been tampered with somewhere on the American continent? The problem was to discover at what points freight cars were being looted.

That was one of the first things to be done in clearing up the mystery of the annual disappearance of all manner of

Thieves who rob and run away are trailed by dogs that have been trained to help save railroad goods.

Here's a Treat for You

IN NEXT month's issue of this magazine we will begin the finest series of detective stories you have ever read. They will be true stories that reveal for the first time how super-detectives are solving baffling mysteries by use of scientific methods that make Sherlock Holmes look like a raw amateur. Here we will give you the real inside stuff on famous crimes—the facts and features the newspapers missed. Edwin W. Teale, writer of these articles, has been working and studying with famous scientific detectives in their laboratories. You will be thrilled, awed, and amazed by his new revelations.

goods, silk, cigarettes, automobile tires, canned food, and other kinds of merchandise worth millions of dollars. Consequently arrangements were made to have freight trains moved through a corridor of police inspections.

Between Chicago and New York a train might stop several dozen times. Nevertheless it was provided that each time there was a stop every seal had to be examined. If a policeman at one stop reported all seals intact and the one who made the next examination discovered that several were broken, that bit of information was a vital aid in recovering the stolen goods and capturing the robbers.

EAST of Buffalo the New York Central police are under the command of Chief James D. Roosa, who weighs about 220 pounds when he is in condition, as he generally is. For some time all his men had been getting regular pistol practice. At night before they rolled into bed, and in the morning as their feet touched the floor, they would practice. They would draw their guns in a manner taught them by an expert, aim at the doorknob, and then squeeze the trigger. Of course they always went through these exercises with unloaded guns. The point is they practiced as faithfully as old-time gunmen of the West. Also they were given frequent opportunities to fire their guns on a range using as a target a swinging silhouette fashioned in the shape of a man.

On a farm in the hilly region south of Niagara Falls, N. Y., there was a man who also practiced with pistols and rifles incessantly. This supposed farmer's hired hands also practiced. The man's name was Perry. He was a Westerner and something of a sinister mystery to his neighbors; but he was no longer a mystery to Chief Roosa and some of his detectives.

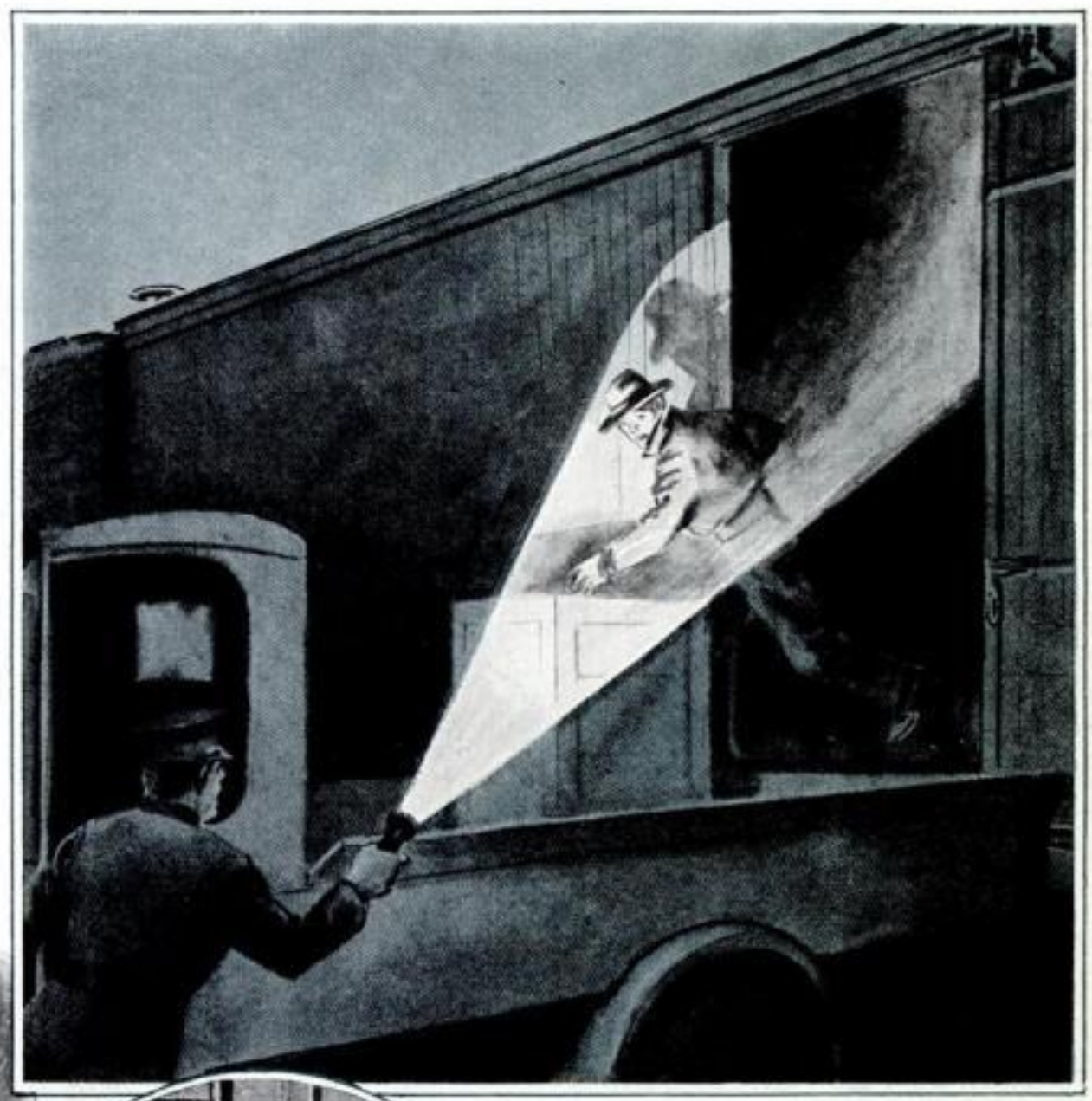
They were convinced that this man was the leader of the most daring gang of freight thieves in the United States. Almost any one of the daring freight robberies within a radius of one hundred miles from Perry's farm might justly be attributed, they felt, to this toughest of all car burglars. But how to catch him?

Chief Roosa stopped shaving for a couple of days; so did ten of his best men. Then, when they closely resembled a collection of tough hoboes, they started north for a section of the railroad known as the Falls Road. It runs from Oswego to Niagara. In some manner Chief Roosa had learned that an attempt was to be made to rob a particular freight car loaded with costly furs.

IT WAS a dark night when that fur car was shunted back and forth in the railroad yards until it had become part of a freight train. Secreted within the car were a couple of tough looking citizens who rode silently in nests they had formed for themselves in the bales and boxes of freight.

Hours later the men within the sealed car heard above the clamor of its thirty-mile-an-hour speed the sound of feet on the roof. Then a heavy body scraped against the side of the car. They waited tensely. The door was pushed open. A strip of blue light relieved the gloom of the car interior. The shooting began at once. It was by no means a one-sided battle.

The invader answered them shot for shot for a space. Then for a second or two that passed as slowly as hours there was no firing. The two men in ambush heard a body crash heavily to the floor. Again they heard steps on the roof, fired up, and waited expectantly. But nothing happened. That other thief had jumped from the moving train into the darkness.



Constantly on the job, the alert railway police, not infrequently surprise robbers in the very act of trying to rifle a car, as shown above.

In circle, seals such as this are placed on the locks of freight car doors. They can be broken easily but always show if they've been tampered with. At left, an officer inspects car door seals. This is done at every stop.

When the freight train stopped at the next station two more of Chief Roosa's men joined the pair in the car. The man with whom they had fought was dying.

Chief Roosa's men hastened back to the point on the right of way where the gun fight had begun. There they found and made a prisoner of a dazed person they identified as an old car thief known as Shanahan. Him they locked in jail, but where was Perry?

Perry, the prosperous farmer, came to the jail boldly to see about getting the release of his hired man and was promptly locked up. Sufficient evidence was dug up to bring a conviction and a prison sentence.

Perry, Shanahan, and a fourth man were given *(Continued on page 133)*

Get in on Television

HERE is your chance to become an expert in the miracle field of sending pictures through the air. At present, George Waltz, author of this article, is not a television expert, but he will be before he gets through. Go with him and learn all that he means to learn about this absorbing subject.

By
GEORGE H. WALTZ, JR.

I SAW something a few days ago that gave me a real kick. I saw, from behind the scenes, the opening night's program broadcast from station W2XCR, the new $65,000 television broadcasting studio in New York City. Besides getting a real thrill out of it, I was inoculated with the television bug.

What if television still is a long way from perfection? What if the picture you see is small and fuzzy and none too bright? With all its present faults, and it has plenty, it still seems almost like a miracle to me.

Chasing distant stations all over the dial of a broadcast receiver used to be a lot of fun. Now with the modern set, distance is so easy it's not exciting and from now on my spare change

Above, Primo Carnera, giant boxer, at W2XCR on its opening night. At left, prominent television engineers get the program in a home.

is going into building me a television receiver. When I finally get one of those flickering pink "visions" on my own apparatus, I expect a bigger thrill than Admiral Byrd got out of discovering Little America!

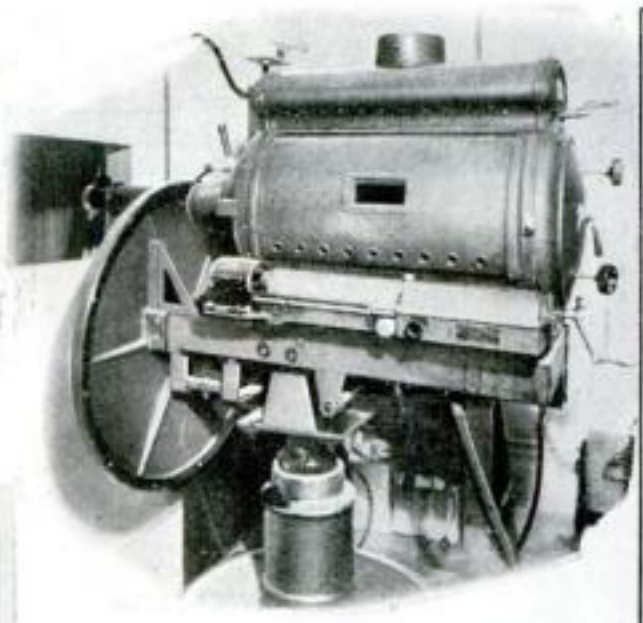
My interest in television began a few weeks ago when I heard over the air a sound like a buzz saw with a couple of teeth missing. I was visiting a friend who experiments in short wave reception. He accidentally tuned in the funny buzz saw noise. He told me the ear splitting wail was pictures coming over the air and he pointed to the television program in the daily paper.

I'd read about television experiments, but actually hearing the signals over the air was what brought the thing to life for me. I determined to investigate and as the first step, I succeeded in getting an invitation to visit W2XCR, where I found out how television programs are put on the air.

At first, as I walked into the television studio, I thought I was in the wrong place. I had expected to find a room filled with weird and complicated looking machinery. Instead it was tastefully draped and for the exception of two small standards supporting the photo-electric cells, it looked quite like any radio studio, several of which I had previously visited. All of the mechanical equipment for picking up pictures was in an adjoining, smaller room that resembled a motion picture booth.

MOST of the space not occupied by studio equipment was filled with people who, like myself, had been invited to the opening night. In the reception room several of them were grouped around a piece of apparatus upon the front of which I noticed a pinkly glowing spot. As I moved closer, it became a picture of a man's head.

Front view of television's scanning mechanism as seen from outside booth.



The scanning mechanism which is in a boothlike room. It can be tilted or turned to follow artist's movements.

Television's control board. Here the operator is looking into the monitor which reproduces image.

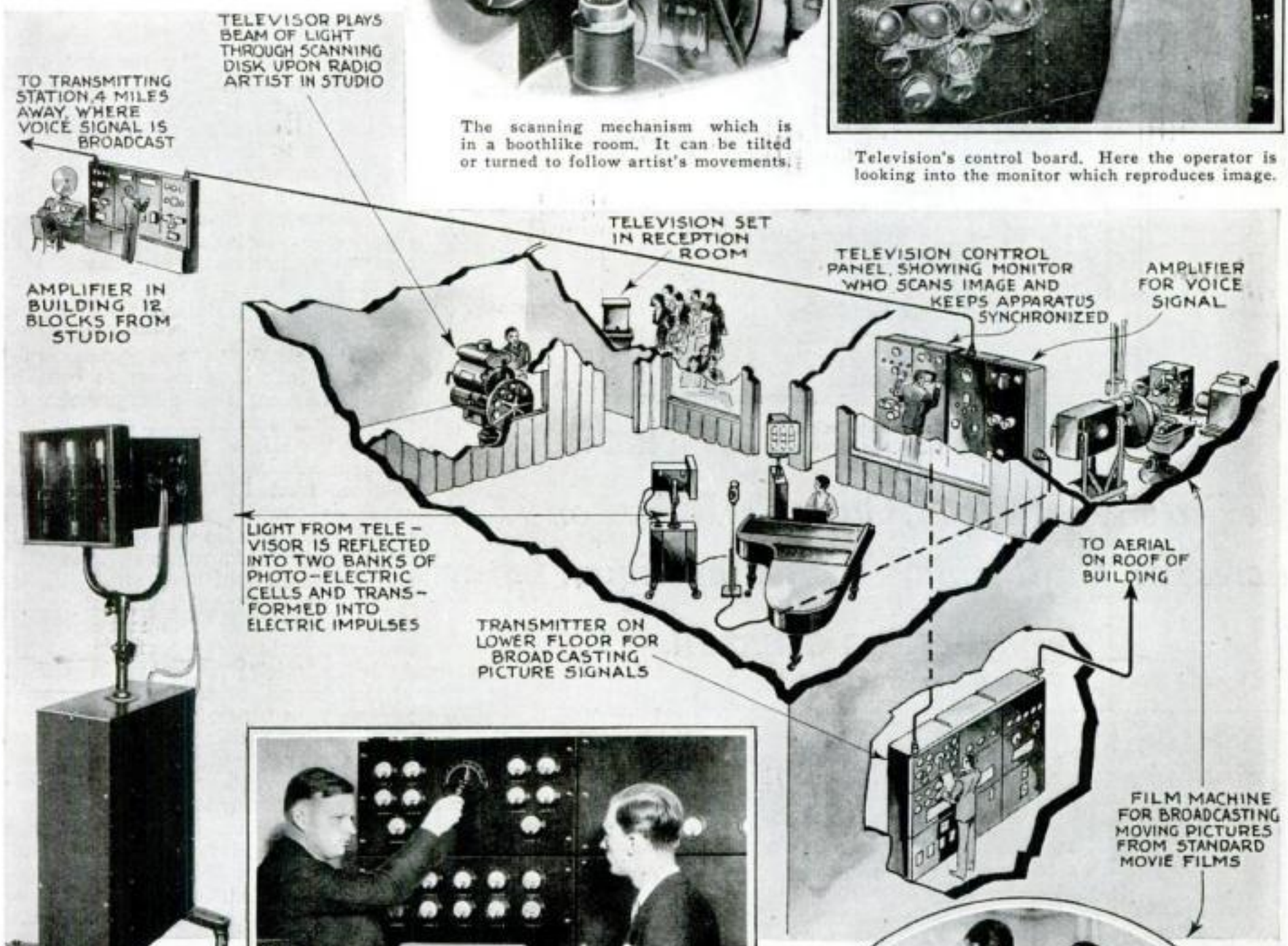


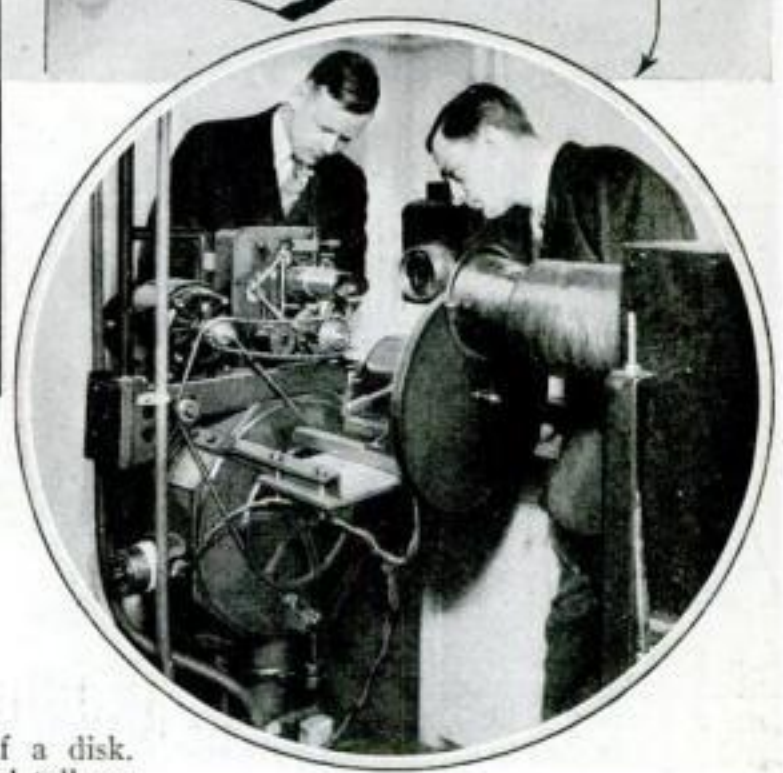
Diagram making clear the operation of a television broadcasting station. Above, photo-electric cell bank. Right, a television transmitter.

I could see him smile and turn his head from side to side. Then I looked through the glass windows that separated the reception room from the studio proper and there in front of some apparatus was the man himself. I had seen my first television picture, for the small outfit we were looking at was the studio's monitor set. It was tuned to reproduce whatever was being televised in front of the big machine.

After all the celebrities present had appeared before the machine and their smiles had been sent out on the air, there followed a brief talk on the equipment used. It did not, however, go into the details I wanted so after the crowd had left I buttonholed Harold Higginbottom, the engineer in charge of the station. He was kind enough to answer the questions that were buzzing around in my head.

"Mr. Higginbottom," I began, "you said the subject's face was scanned by means of a disk. Could you show me the disk and tell me just how it works?"

"Do you know how ordinary broadcasting is done with a microphone?" he asked as he snapped on a light over the scanning mechanism *(Continued on page 136)*



Harold Higginbottom, left, engineer in charge of station W2XCR, explains to the author the operation of the film pick-up device that is used to broadcast ordinary motion picture film with sound accompaniment. The photo-electric cell is in the large black box at right.

We Now Grow Our *Own* Rubber

On the plateaus of northern Mexico, this rubber producing shrub, guayule, grows wild.

Photos Courtesy American Rubber Producers, Inc.

Mexico's Wild Weed, Guayule, Raised on 5,600 Acres in California, Yields Precious Latex

By STERLING GLEASON

On a 5,600-acre tract near Salinas, Calif., "guayule," a shrub imported from the highlands of Mexico, is being grown on a huge scale. When ground to a pulp in machines much like those of a large ore mill, this queer plant yields from thirteen to twenty percent of its own weight in pure raw rubber.

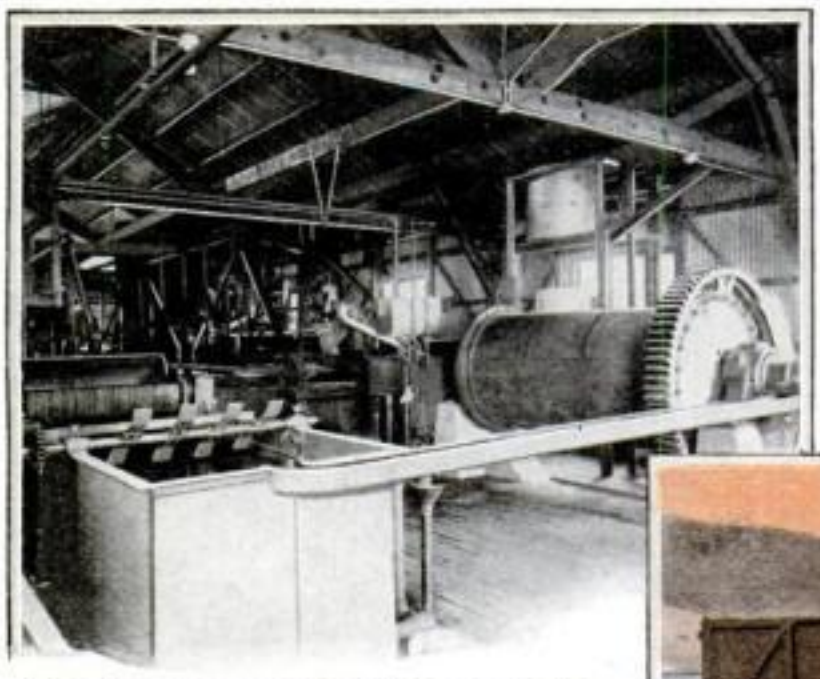
The California rubber project represents the triumph of scientists who for years have been searching the world over for a rubber-producing plant that could be grown in the temperate zone. Great automatic machines are now flinging forth a challenge to the rubber plantations of the tropics, where for years man has bled the hevea tree of its sticky sap. This tree, from which almost all of the world's supply of rubber is derived, grows only in a narrow section near the equator.

ALTHOUGH plants and trees bearing special tubes filled with the milky "latex," or sticky sap which becomes rubber, have long been known to exist in North America, few gave promise of practical commercial value.

Only when it was discovered that in northern Mexico and southern Texas an immense tract 130,000 square miles in extent is covered with a native weed whose juices contain the precious latex, did American-grown rubber begin to influence the markets of the world.

The strange desert shrub that secrets tiny cells of rubber in its bark and wood first came to the attention of science when American mining engineers in central Mexico found peon children chewing guayule twigs for material to make crude rubber balls. Starting with a bit of bark or the wood of the plants, and spitting out the splinters as they chewed, the children would get tiny balls of rubber.

This simple trick had come down to them from ancestors during the centuries. Companions of Cortez, on his second voyage to America, found natives of southern Mexico playing a game much like modern tennis, with balls "so elastic that when they touch the ground, even when lightly thrown, they spring into the



The chopped-up guayule bush goes into the vats in this part of the factory at Salinas.

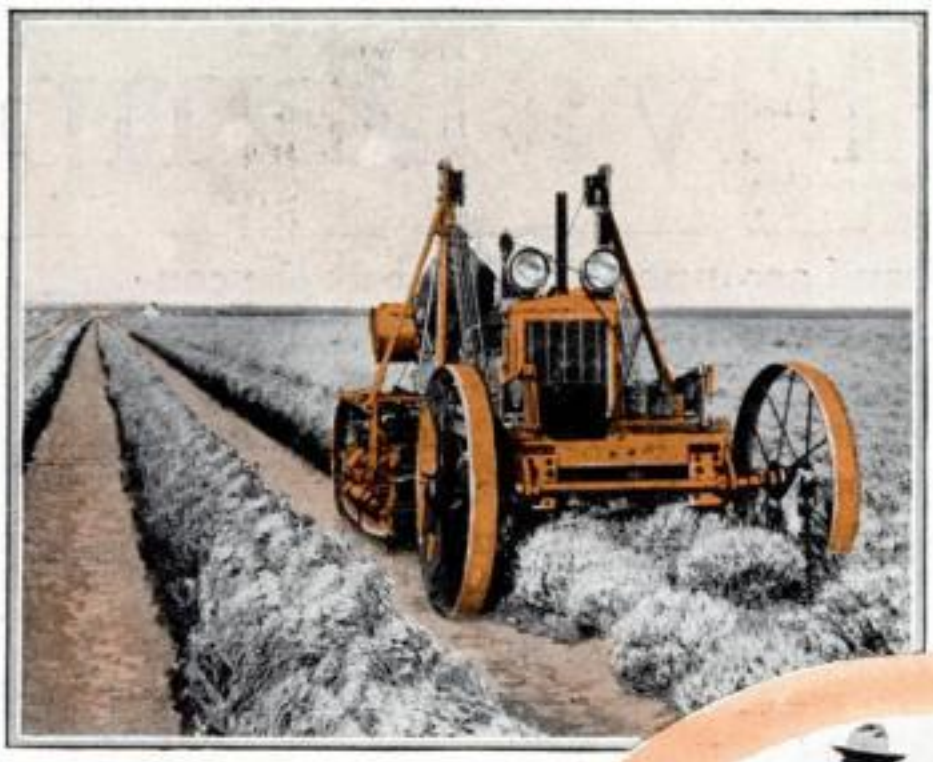
ACROSS the level surface of a sun-baked valley in central California, tractors drag strange, clanking machines down long, parallel rows of a grayish-green shrub that looks, at first sight, like sagebrush.

In a near-by mill, giant crusher rolls grind dried bushes to a pulp, while steaming, high-pressure hydraulic chambers spew forth myriad tiny cellular particles the size of a grain of wheat.

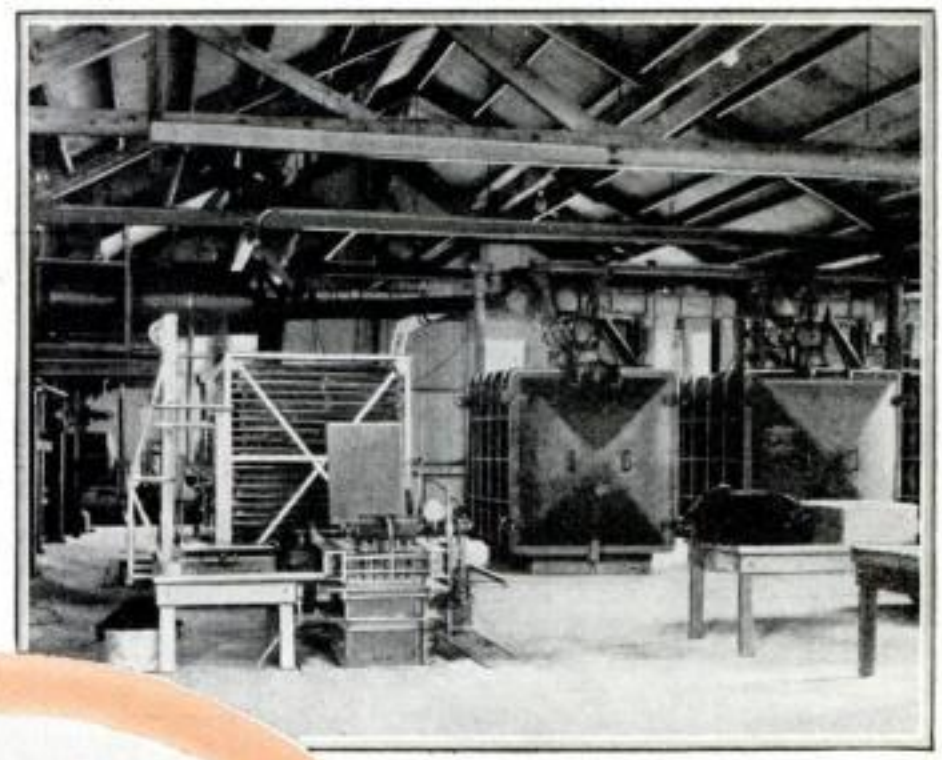
In the yard outside, men load freight cars with rectangular pine boxes filled with a spongy, porous material, whose acrid smell is strangely familiar. It is rubber—produced commercially on American soil for the first time in history.

Mechanized American efficiency now promises to produce the crude rubber of industry at a cost that can successfully compete with the product of the labor of coolies who are virtually slaves.

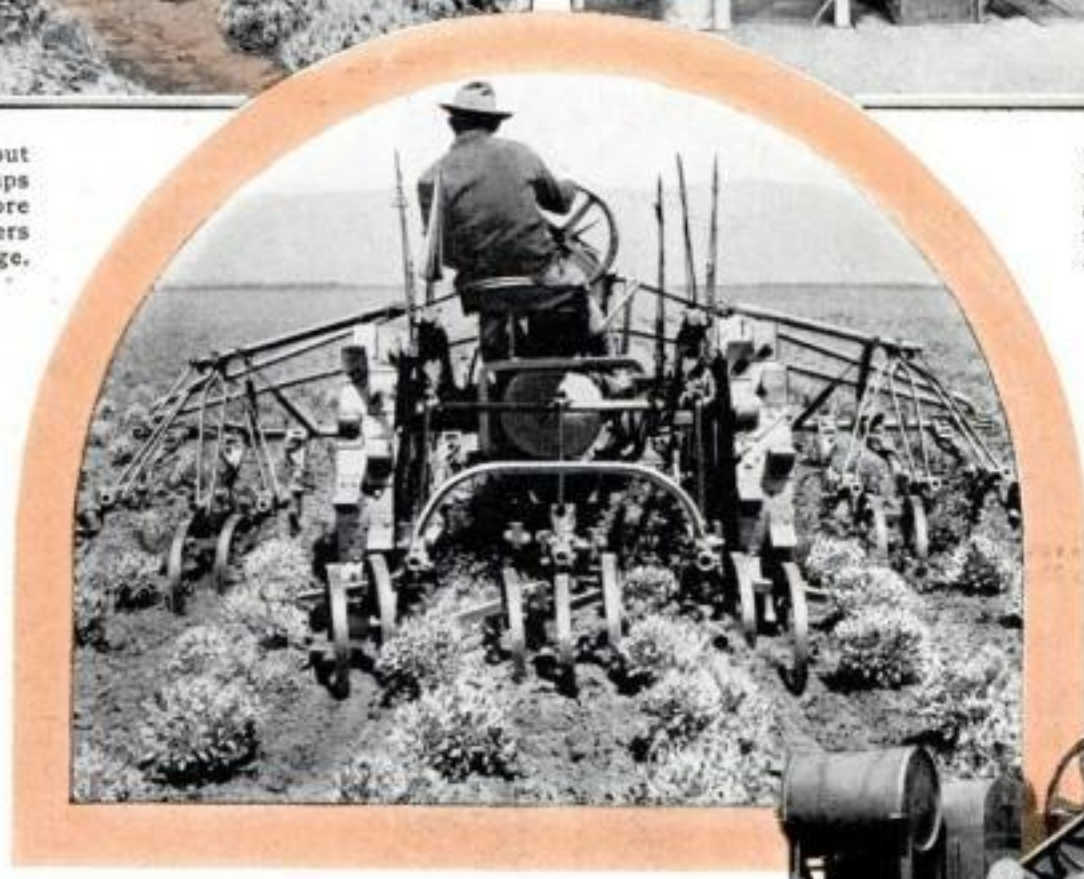
A harvester at work on the rubber farm at Salinas, Calif., where 5,600 acres of guayule shrubs are under cultivation. This machine picks up plant, chops it to pieces, and blows it into the truck.



This guayule harvester digs out four rows at a time and dumps them into neat piles to dry before the chopper and blower gathers them as shown on opposite page.



The guayule shrub when it is brought to the factory contains a large amount of water. In this room steam and pressure remove all but a fraction of the moisture.



At left, view of the six-row cultivator with which the soil is stirred up and weeds killed while the young plants are growing.

air with the most incredible leaps"—astounding to the Spaniards, who knew nothing of rubber.

In the guayule bush, the rubber is contained in cells in all parts of the bush except the leaves, entirely surrounded by cellulose. In the rubber tree it is in the sap. Nature seems to have intended it to perform entirely different functions in the two plants. In the rubber tree, it forms a sticky residue when sap flows out of a cut or wound and thus protects it, keeps insects out, prevents decay, and helps the wound heal. But in the guayule bush, the rubber is evidently stored up as reserve food. In the goldenrod, and other plants which have been found to contain rubber, it is located mainly in the leaves, and its function is unknown.

BRIDGING the gap between the wild weed known to the Indians of Mexico three centuries ago and the modern domesticated shrub, raised on American farms like sugar beets or potatoes, lies a strange story of patient search closely paralleling the amazing work of Luther Burbank.

Guayule rubber first came to the United States when samples were sent from Durango, Mexico, to the Centennial Exposition at Philadelphia in 1876, but it was eighteen years before the first commercial guayule rubber was produced in Mexico. It was sticky and soft, vulcanized poorly, and had a low tensile strength. Rubber experts scoffed at this product of a weed. Heavily laden with unwanted resinous compounds, it could never compete with the pure latex that oozes from the hevea tree.

Yet the need for more rubber became acute as the automobile chugged its way from the inventor's workshop into American life. The immense Mexican tracts of guayule were looked upon as a source from which rubber might be obtained. In its laboratory, the Diamond Rubber Company, of Akron, made first-class rubber from guayule but the cost was too high to be of practical value.

Meanwhile, factories were set up in Mexico, where various companies spent hundreds of thousands of dollars in attempts at commercial manufacture—and "went broke." As many as thirteen different enterprises tried their hand at guayule extraction, but could not make ends meet, although they produced as much as 150,000,000 pounds of rubber in a single year, and decimated the immense guayule fields of our southern neighbor.

THE shrinking supply of wild guayule made it evident that a cultivated variety would have to be developed if a steady production was to be obtained. In 1907, the Continental Rubber Company began to cultivate the guayule on its Cedros range in Mexico; but when the guns of revolution boomed, laboratory work stopped.

Large quantities of seed were then brought to central California, where tracts of land were set aside near Salinas as a nursery laboratory for research purposes. Here began a long series of experiments directed by Dr. W. B. McCallum.

Working on the principle of a vacuum cleaner, this seed gathering machine goes through the field collecting seeds.

At once he exploded two popular fallacies regarding the guayule: First, that it would not reproduce itself from seed; and, second, that the wild plant, when grown commercially in the field, would not produce rubber.

As the seed had been taken from plants on the range, it was inferior, and contained much chaff. As the prophets had predicted, it would not germinate. As an alternative, Dr. McCallum tried planting cuttings from the shrub, but with scant success. Out of many thousands of cuttings set out, fewer than one hundred grew, and those that did take root were lacking in vigor and vitality.

Chemists and botanists went into consultation. After countless experiments, they learned to treat the seeds by chemical and other means, so that at least ninety-six out of every hundred would germinate. *(Continued on page 120)*

Anyone Can Fly a Blimp

To this portable mooring mast the nose of the big incoming airship is fastened by the co-pilot.

This first-hand account of a novice at the controls of an airship is so graphic and thrilling that you cannot fail to be delighted with it. You will find it all the more interesting because, while airplanes have become commonplace, comparatively few have ridden these gas bags.

By ANDREW R. BOONE

In his enthusiasm at the way the blimp maneuvered, the author, right, forgot he was at the controls and letting go of them tried to tell Pilot Smith all about his own ship.

SMITHY stuck his head out of the port window.

"Give us a weigh-off," he shouted, raising his voice to get it past the roar of the two engines.

The ground crew, stepping back from the car, slackened all ropes. Instantly the *Volunteer* began to rise from the Goodyear air dock. And as suddenly all hands grabbed the ropes and the rail running around the bottom of the car.

Across the field came one of the more distant crew members, a canvas bag, heavy with sand, clutched in each hand. Through the starboard door he swung them onto the floor of the car.

"Now we're in equilibrium," Smithy explained. "With this wind (it was blowing eight miles an hour from the southwest) we can fly her off."

The blimp held steady, neither rising nor settling down on its lone air wheel. She had just enough positive buoyancy to help her up when the motors began to roar.

"Ready?" asked Smithy.

"Okey."

His gloved hand waved to the ground crew. Two of them ran in with the long ropes and coiled them in two dump boxes near the nose of the car; four on the car shoved upward. The motors roared and up we shot, at an angle no pilot would be silly enough to try with an airplane.

Five degrees, ten, fifteen. I was fascinated. It had been thirteen years since I had been aloft in a blimp, the Navy's old *B-18,* an open-cockpit hydrogen-filled ship. In the *B-18* I had my first trip aloft. As I climbed into the cockpit one of the officers standing on the ground pointed to a rope that trailed down alongside the cockpit.

"Grab it and jump if anything happens," he shouted.

On the top end of the rope was a parachute. Untrustworthy as it may have been, it was better to clutch the three-quarter-inch manila than to ride a burning hydrogen bag down. In these modern blimps, however, there is no fire hazard. Helium will not burn and for that property blimp owners pay $60 for each thousand cubic feet. It costs $4,500 to fill her with 76,000 cubic feet of helium, and nearly $100 a month to replace in the envelope the helium that seeps through the rubberized fabric.

Pilot Verner Smith, left, explains to Boone the shock cord mechanism of the one air wheel upon which the *Volunteer* rests when on the ground.

Here we were, comfortable in upholstered chairs, looking out from an inclosed five-passenger cabin, suspended beneath a gas-filled bag that, barring some nearly-impossible accident that would tear a great hole in the top, would bring us to earth under any circumstances. No parachutes here—no need for them.

WERE the blimp to become disabled, the motors to stop, Smithy would merely free-balloon her down again on some level spot, deflate the bag if necessary, and wait for help. These blimp pilots, you see, must become pilots of free balloons before they're trusted with one of the six in the Goodyear fleet.

Above, *Volunteer* comes in and the ground crew grab landing lines; right, Smith signals crew, "We're coming down."

Eleven hours in a free balloon, including night ballooning and solo, before they can begin to qualify as blimp pilots. The *Volunteer* and her five sister ships are nonrigid blimps, in reality balloons shaped to give them directibility and carrying motors to give them forward movement.

Bags of sand are put into a blimp to establish its equilibrium; that is, to give it just enough stability to hold it from rising or settling down.

WHILE flying a blimp is much more simple than flying an airplane, these boys must fly them 200 hours before being turned loose with the public. But here I was, ready to learn how to pilot a blimp in one easy lesson. After a few jerks and near-stalls I did manage to keep her on an even keel. Therefore, in all logic, I may say I can fly a blimp.

As Smithy—Verner Smith, to be more formal—rolled the elevator wheel back and the tail controls caught, our nose rose and we climbed steeply out of the field and over the high tension wires that cross every block in an industrial district. From Long Beach, twenty miles away, a fog had rolled in earlier in the morning, but now the sun was showing in patches here and there.

We were glued to our seats. The engines, while not running as fast as motors turn to pull airplanes out of small fields, forced the blimp upward at a lively clip—possibly twenty-five miles an hour. I glanced at the altimeter—300 feet.

"How high are we going?"

As I shouted the question into Smithy's ear the noise suddenly stopped. Instinctively I grabbed the window sill, looking over the side for a landing place.

The *Volunteer* pitched gently back and forth. In a moment we were riding on an even keel. Smithy grinned. Then as the wind blew us gently toward downtown Los Angeles while the engines idled he told me of experiences with airplane pilots.

ONE day several months ago he took Ernie Smith—who, with Emory Bronte, flew across the Pacific—up for a "blimp hop" at Oakland. Smithy shoved the nose up and cut the gun when one hundred feet off the ground. Ernie took one glance at the instruments, then began looking for a landing place.

"Invariably," Smithy explained, "people accustomed to airplanes expect the blimp to nose down and spin when the engines are idled. But you can't spin one of these ducks. And you can't loop-the-loop or stall them."

HE PROCEEDED to show me. Backward the elevator wheel turned. Up climbed the green column of liquid that measures the angle of climb. Ten, twenty, thirty degrees—and the column hit top. An airplane, climbing at that sharp angle, would have fallen off on one wing and spun earthward. But the blimp merely continued to climb at the rate of 1,200 feet a minute, until Smithy throttled the engines and the ship leveled off in easy flight.

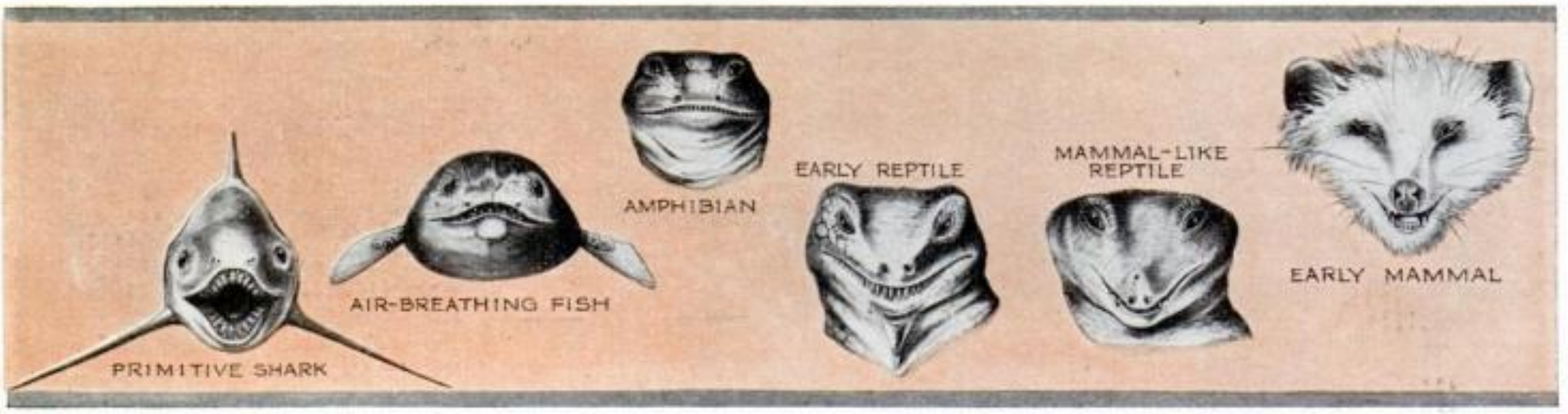
"But," I said, "if you nose dive this cigar and pull her up sharply, why can't you come close to looping the loop?"

For reply he put the *Volunteer* in a steep dive; steep, that is, for a blimp. The controls lifted the tail just so far and no farther, for the weight of the car, hanging amidships, prevented the tail going higher. After sliding down a couple of hundred feet, he rolled the wheel back again and we swung forward like a big pendulum as she lumbered upward. Again the green column passed the thirty-degree mark, but we did not go on over. In fact, it's impossible to turn these "flying cows" on their back. And therein lies one of their greatest factors of safety.

AFTER Smithy had throttled the engines down to idling speed he told me how so much strength has been built into these bags. It was interesting, especially because the bags keep their shape by the pressure of the gas. There are no cross members to strengthen them, as in the *Graf Zeppelin* and the giant blimps being built for the Navy.

"The *Volunteer,*" he explained, "carries 96,000 cubic feet of helium and air. In the bottom of the bag is a smaller, oval cell we call a balloonet. It contains about 20,000 cubic feet of air. When we go up into thinner air, the helium's pressure rises. Then it presses against the balloonet and forces air out through a valve. In this way the pressure on the bag does not increase and we keep all our helium. One of the air scoops, which faces into the propeller blast, remains open to keep a little pressure in the balloonet, and when I come down for a landing I open the other. That increases pressure in the balloonet, which presses upward against the helium compartment and keeps the entire bag rounded out.

"Of course, when we're flying fifty miles an hour, which is near our top speed, the bag would *(Continued on page 126)*



WE GOT *Our* FACE

What They Talked About:

LAST month, Dr. William K. Gregory, world-famous scientist of the American Museum of Natural History, told Michel Mok, staff writer, how the earth and life originated. About two billion years ago the earth was torn out of the sun by the passing of another star. Slowly it condensed and cooled down. A billion years later, chemical forces created tiny bits of living jelly in the primeval puddles. These developed into colonial cell groups, into small wormlike creatures, into air-breathing fishes. Finally, some ventured out onto dry land.

The Thrilling Story Continues:

MR. MOK: Dr. Gregory, you told me in our last talk that the primitive air-breathing fishes that crawled out of the water hundreds of millions of years ago were the ancestors of man. Yet, men don't look like fishes; at least, most of them don't. We don't look like any animal. Where did we get our looks? Where did our face come from?

DR. GREGORY: You got your face from a fish; in fact, you got it from a shark. But before we go further, let me ask you a question. Do you know what a face is?

MR. MOK: The front part of a head.

DR. GREGORY: That is not entirely correct. The head, you see, consists of the brain case and the face. The forehead is part of the toppiece. Draw a line across your eyebrows over the tops of your ears, and everything under that, to the top of your Adam's apple, is your face. Most people think the forehead is included. That is not so. If it were true, then the balder a man, the higher his face would extend. But all this does not explain *what* a face is. So far, we have only decided *where* it is. Try again.

MR. MOK: Well, I might say that the face is the fortune of some and the misfortune of others.

DR. GREGORY: That answer is scientifically almost right. The face *is* the fortune of all animals; they literally make their living with it. Among people it is sometimes a misfortune. But that is because we have invented all sorts of new functions for the face.

MR. MOK: New functions? What are they?

DR. GREGORY: First let's see what the old or original functions are. The face is two things in one. Primarily, a trap to catch food. Secondly, an instrument board on which are mounted the receiving parts of several instruments of precision, such as the eyes, the ears, the nose. The purpose of these instruments is to take the owner of the face to places where he may find food to catch in his trap, and to warn and take him away from dangerous neighborhoods.

MR. MOK: That is true of animals. But what do *we* do with them? What did you mean by "new functions"?

DR. GREGORY: We use our faces to catch mates, play poker, make political speeches, and for a number of other things peculiarly human. Since man is the latest species of animal to arrive on earth, these uses are new. Now, if a man's face is not adapted to one of these uses, he is, as the saying goes, out of luck. That is why it is only among people that the face may be a misfortune. An animal is never out of luck on account of its face. It always serves its purpose, except when severely injured.

MR. MOK: But why do you say that we got our face from a fish? Last month you told me that we parted company with our cousins, the apes, about ten million years ago. I should imagine that our face came from them.

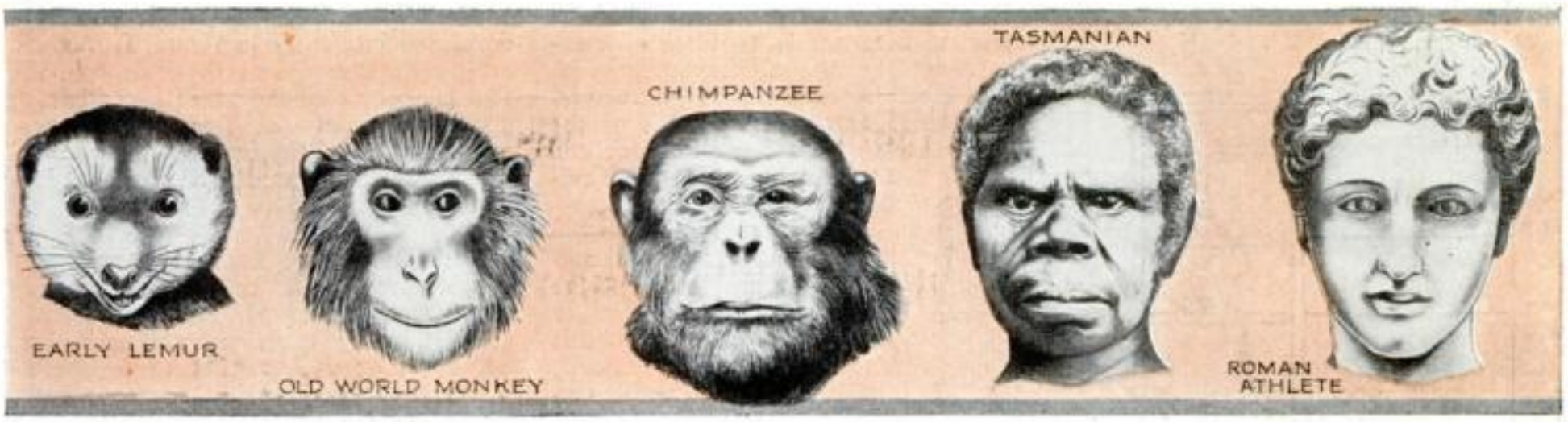
DR. GREGORY: It did. But it goes much further back than that. Suppose a man inherits a gold watch from his father, who, in turn, had received it from his father, and so on, for several generations back. Wouldn't it be entirely true to say that the present owner got that watch from his great-great-grandfather?

MR. MOK: Of course.

DR. GREGORY: Well, we got our face from a fish in somewhat the same way. The difference is this: When you inherit a watch, the entire, ready-made article comes down to you unchanged. In the case of the face, our earliest ancestors left us only the "works," that is, the ground plan. Each succeeding group of animal ancestors modified it, added touches of their own, or lost some part or other.

MR. MOK: What were these succeeding

Apes, like this chimpanzee, laugh, grin, and smile but their smile may mean anger. The two expressions are much alike.



FROM A FISH

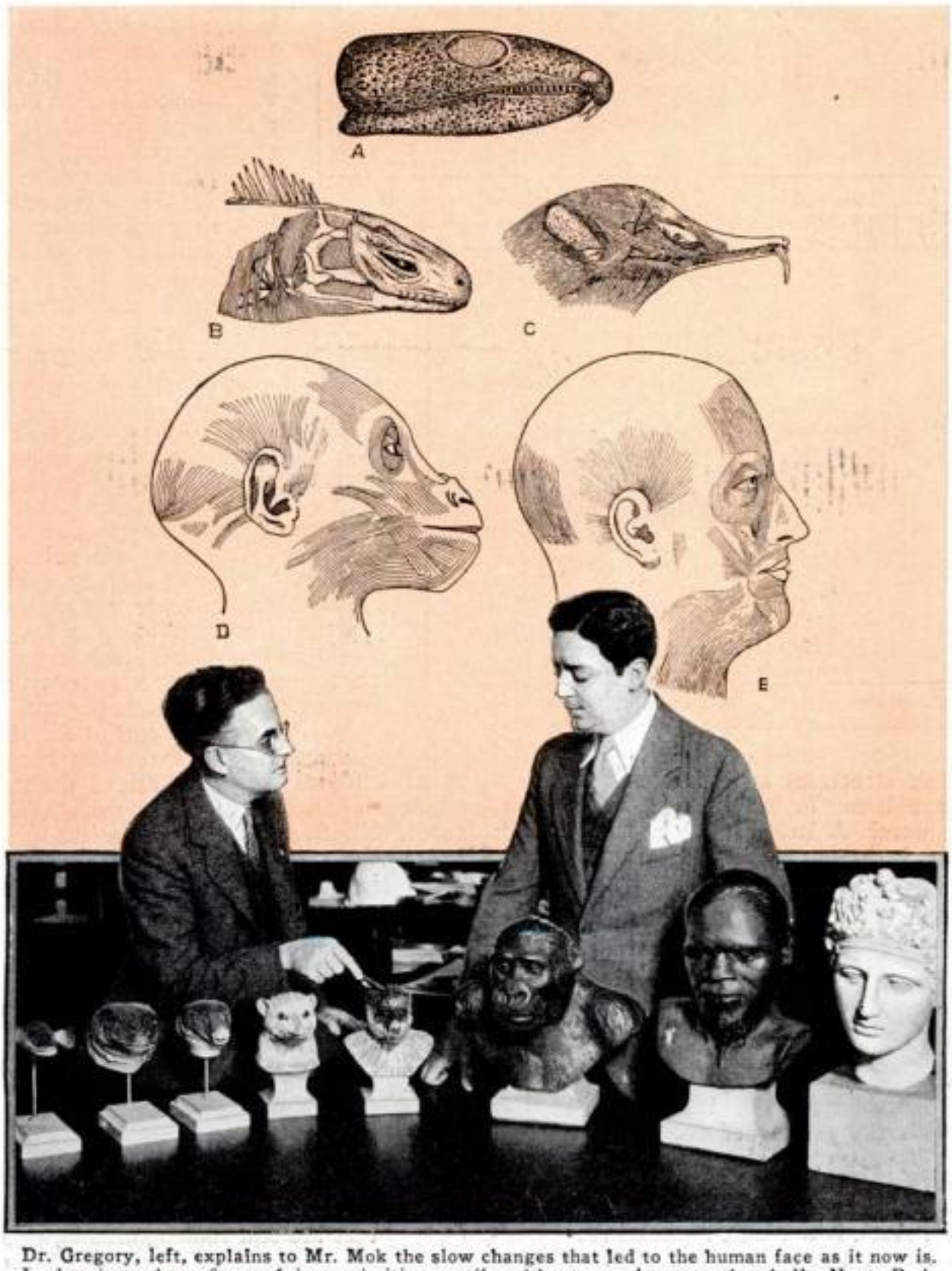
Nothing else is of such supreme interest as the gripping and vital story of "Life—The World's Greatest Mystery." Here is the second installment of the dramatic history of man's rise from a mass of floating jelly to the human being he now is. In a most striking manner a famous authority details the amazing facts about the molding of the human face.

groups of our ancient animal ancestors?

DR. GREGORY: Briefly, the ape got its face from the early monkey; the monkey from the opossum; the opossum from the lizard, and the lizard from a fish. You can visualize this line of succession best by picturing it as a staircase. You stand on the top step. The ape stands on the first step below you, the monkey on the second step, and so on down. But you must understand that each of the animals I named is the modern representative of great groups of numerous species that lived ages ago.

MR. MOK: How many years are represented by each of your steps?

DR. GREGORY: The apelike creatures lived from ten to twenty million years ago, the early monkeys from twenty to fifty million years ago, the opossums from fifty to one hundred million years ago, the lizards from one hundred to three hundred million years ago, and the fishes from three to five hundred million years ago. These are not wild guesses. The length of each of these periods was established by the radium clock which I explained to you last month. So, you see, your face is quite an antique.



Dr. Gregory, left, explains to Mr. Mok the slow changes that led to the human face as it now is. In drawings above figure *A* is a primitive reptile without muscles over the skull. Next, *B*, is a modern reptile with an open skull covered with thick skin. At its right, *C*, a primitive mammal in which muscles have grown forward over the face. The next drawing, *D*, shows gorilla with well developed facial muscles which you can compare with those in the man's face near him.

MR. MOK: I had no idea I owned anything as ancient as that. You mean, then, that the fishes were the first creatures that had faces?

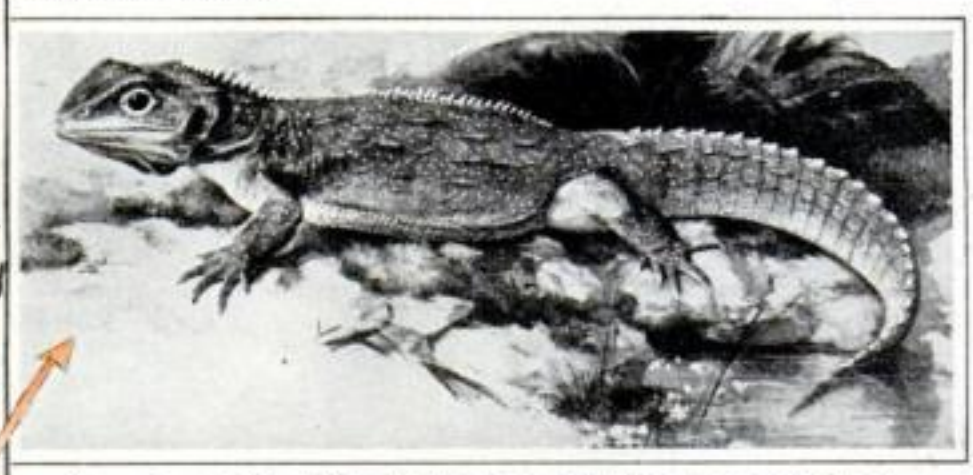
DR. GREGORY: They were the first creatures that had anything resembling a *human* face. Other, earlier creatures had faces of a sort, but they were not at all like ours. They looked more like the faces of worms.

MR. MOK: In what way does the face of a man resemble that of a fish?

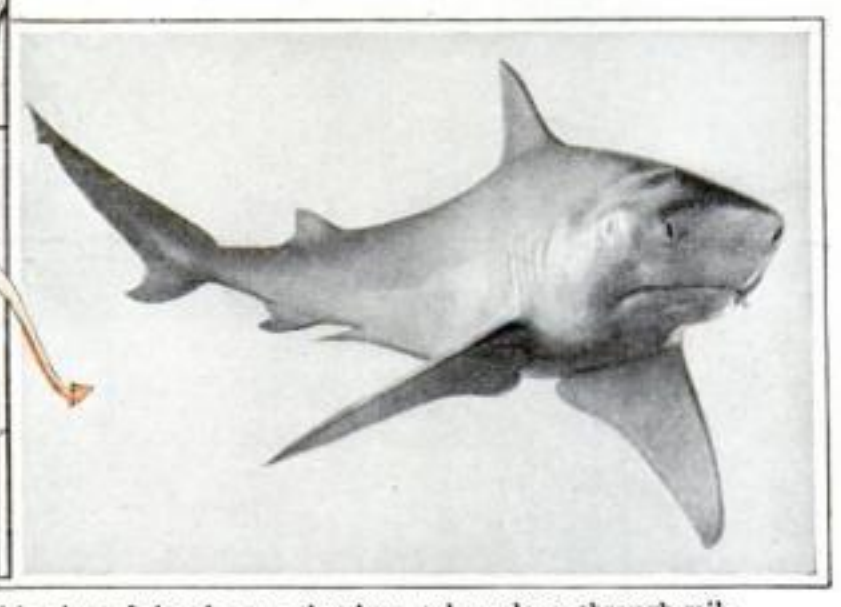
DR. GREGORY: A man and a fish have the same facial outfit. The same parts are arranged in the same order. In both, the smelling part is in front of the eyes; the eyes are above the jaws; the jaws are below the brain case. The only fundamental difference is that a fish has no external ears.

This ladder of life gives a graphic view of the changes that have taken place, through millions of years, indicated at left, from the early sea life up to the mammals, apes, and man.

The opossum, unchanged after eons.



Above is an 18-inch lizard that is exactly like its ancestors of 200 million years ago. Below, a shark whose face plan is like ours.



DR. GREGORY: Of course not. And the reason it does not is that such resemblances don't exist, except in your imagination. Real resemblance is structural resemblance. Our face and that of the fishes resemble each other in structure. Structural resemblance *is* evidence of descent.

MR. MOK: Why?

DR. GREGORY: Because animals that are known to be related resemble each other in structure. The opposite is also true. Take, for example, the bulldog and the Russian wolfhound. On the surface, they look quite different. Yet, through their structure, the descent of both has been traced to the same wolflike animal.

MR. MOK: But even if their structures are alike, couldn't they have been "designed" independently, as it were? A Rolls Royce and a Packard are both automobiles. Their structures resemble each other a good deal. Still, they were built in different factories.

DR. GREGORY: Very true. However, the history of the automobile shows that they are related. They are both modifications of the same crude horseless buggy of forty years ago. Do you see the point?

MR. MOK: I do. What I don't see is why you singled out the shark as the particular fish that gave us our face.

DR. GREGORY: Simply because the shark is the least modified survivor of the early vertebrates, or backboned creatures. In other words, the shark has remained in the horseless buggy stage, while man has developed into a modern car. To put it a bit differently, the shark, or dogfish, to this day carries around with it the original ground plan of the human anatomy, including that of the face.

MR. MOK: Where did the shark get its face?

DR. GREGORY: Probably from some wormlike water creature. We don't know exactly what kind. There are several theories, but the question is still up in the air. What we do know is that the shark is much closer to us in anatomy and appearance than it is to any of its invertebrate, or backboneless, ancestors.

MR. MOK: Very flattering—for the shark. But if we developed from the shark, why is it that the old shark is still with us?

DR. GREGORY: The present shark is a descendant of a conservative branch of the shark family. You and I are descendants of a progressive branch. In a way, it is the same situation you observe among people. Let us suppose that one hundred years ago there were two brothers, the sons of a poor night watchman. The older got ahead in the world; the other stayed poor. Today, a descendant of the older brother is the millionaire president of a large corporation, while the great-grandson of the other is still a night watchman. Is that clear?

MR. MOK: Yes, but what was the cause of the split among animals?

DR. GREGORY: Nobody knows. We do know, however, that in every age of the history of the earth, descendants of the conservative and progressive branches of the same old animal families have lived side by side.

MR. MOK: How do you know?

DR. GREGORY: Geologists have found fossils of both kinds in one rock layer; that is, a rock layer formed during a definite period in the history of the earth. All of the rock layers that have been examined, each of them formed during a different period, have yielded such "conservative" and "progressive" fossils.

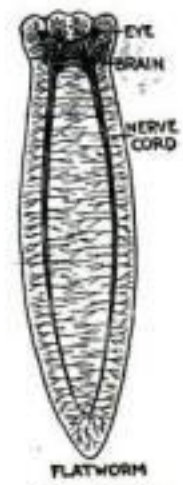
MR. MOK: Then the shark, you might say, is a fossil that has survived?

DR. GREGORY: Exactly. As a matter of fact, we call it a "living fossil." The opossum is one, too. They are animals that have not progressed in hundreds of millions of years. A little while ago, I compared the shark to the old horseless buggy. But there is a difference. The first automobiles are no longer in use. They are on exhibition in museums, as curiosities. The living fossils, on the other hand, are like horseless buggies that are still running around, side by side with the Rolls Royces and *(Continued on page 121)*

MR. MOK: I think that is only a sketchy resemblance.

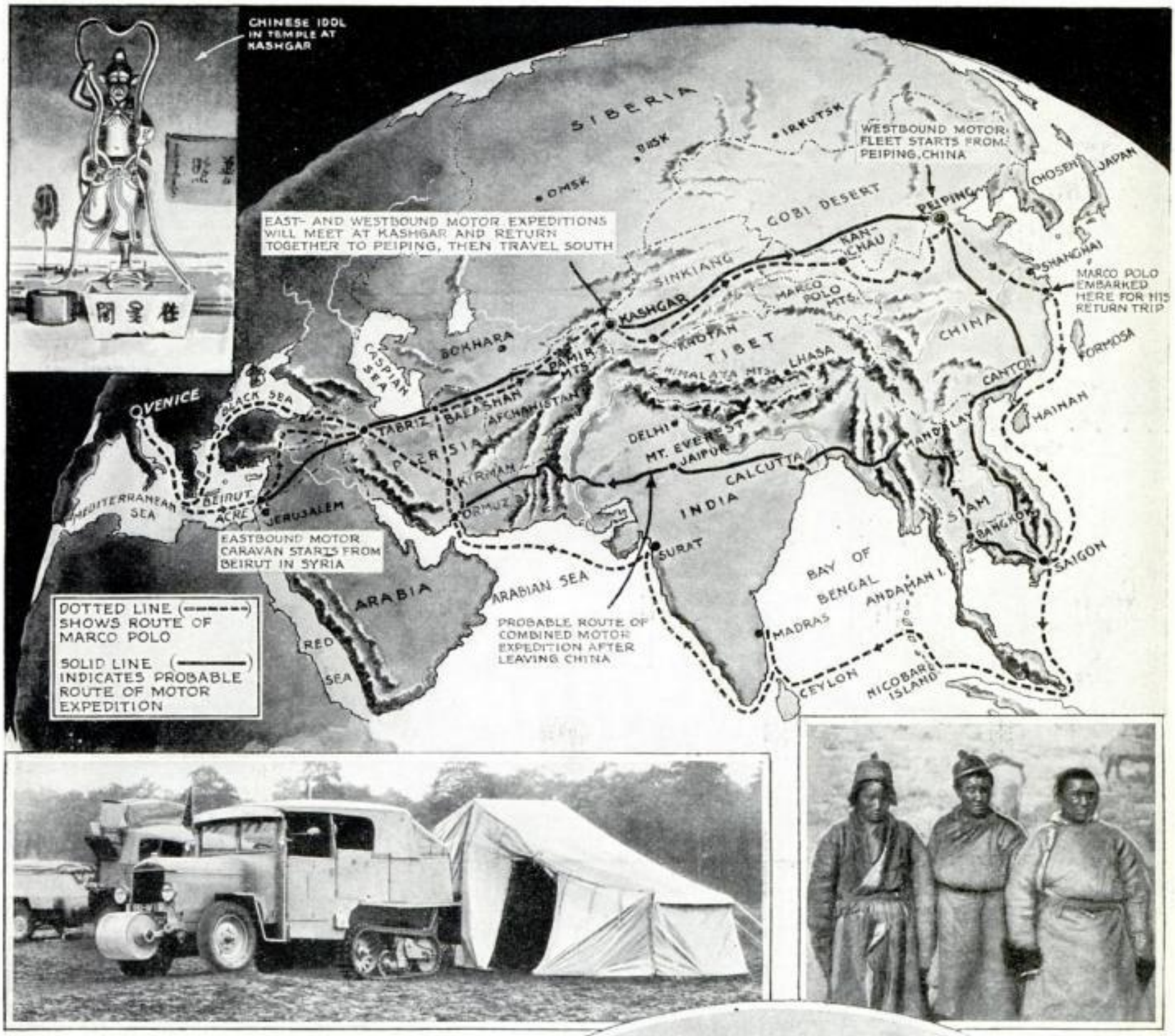
DR. GREGORY: It would be if that were all. But the resemblance goes much deeper than that. The very same bones in the jaws of the fish that it uses to catch other fishes also serve us to eat it. We have inherited the bones of the tongue and of the throat from the fishes. The muscles that move our jaws and tongues are modifications of those of the fishes. The way our brain is divided into its main sections is the same as that in the fish. Now, have I convinced you that you look like a fish?

MR. MOK: Not completely. But, even granting that a man and a fish do resemble each other, I still don't see how that proves that the fishes were our ancestors. A man may have a face like the moon; a pretty child may look like a flower. That does not prove any relation, does it?



A lowly flatworm, showing basic features of our face.

Strange Cars to Follow Marco Polo's Asiatic Route



Above, rollers in front can be lowered to keep the car from sinking in sand. Right, Mongols, a constant threat to party.

© Haardt Trans-Asiatic Expedition.

MORE that 600 years have elapsed since Marco Polo, famed Venetian explorer, told of fabulous sights he saw in journeying across Asia—yet much of his route has never been retraced by white men. But at this writing, two fleets of French motor cars with caterpillar treads were waiting the word "go" at Beirut, Syria, and Peiping, China. When they start on Marco Polo's trackless trail, the Haardt Trans-Asiatic Expedition will be in full swing. Radio, color cameras, and talking picture apparatus will record the trip.

Some of its cars employ a unique anti-miring device—a round cylinder at the front, which can be lowered to keep them from sinking in marshes or sand. Each car carries five men and tows a trailer.

"Mountain type" cars for the eastbound party have airplane-type superchargers to help them over the high passes.

The National Geographic Society is coöperating in the expedition. It is led by Georges-Marie Haardt, French explorer and conqueror by motor of the Sahara.

Photo Courtesy National Geographic Society

This is the type of country across which the cars equipped with superchargers like those in use on airplanes will make their way. This view was taken in the vicinity of the Marco Polo Mountains. No autos have ever been seen by natives along large sections of the expedition's route.

Plans Rocket Driven Bomb to Chase and Wreck Plane

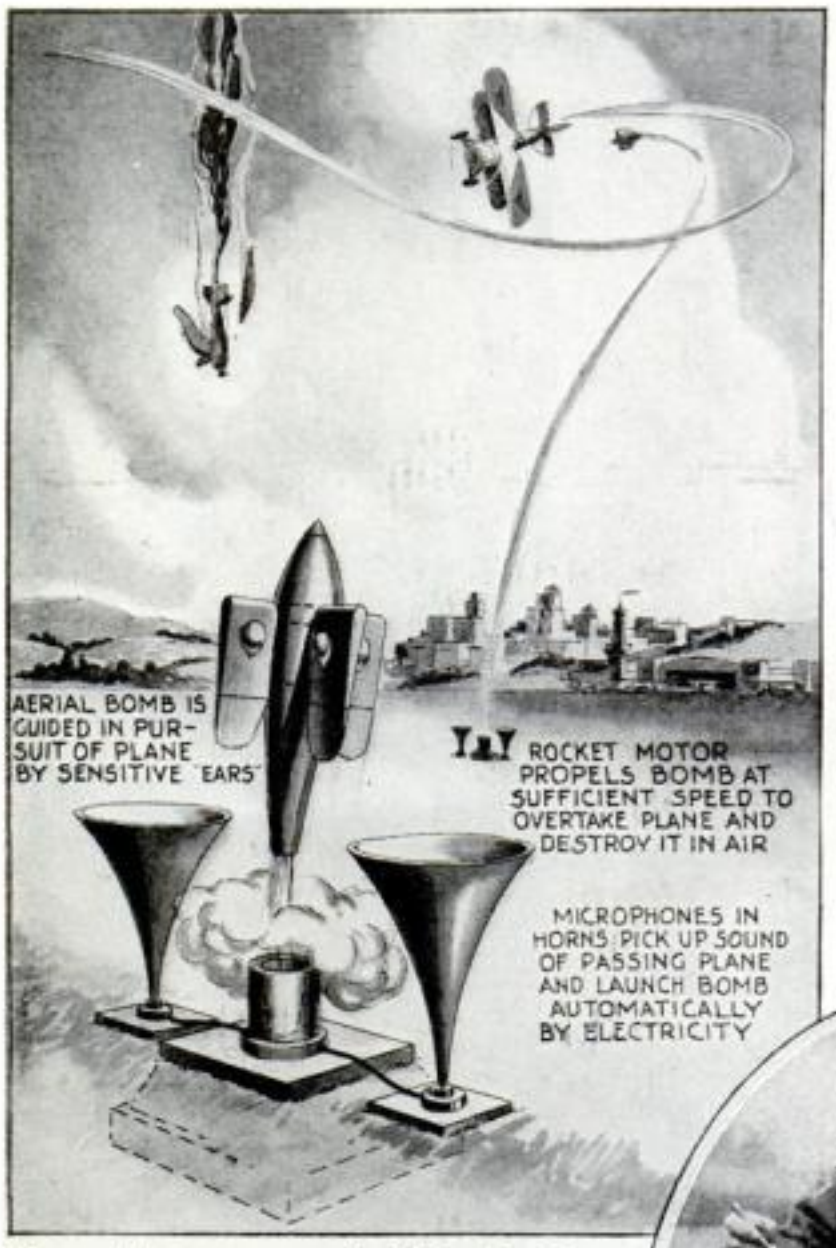


Diagram illustrates manner in which rocket-driven bomb would pursue and destroy an airplane. It would be drawn toward the plane by the sound of the motor. At right, Dr. Gustav Rasmus, the inventor.

A BOMB that could chase an airplane in the air and destroy it is the amazing war weapon proposed by a San Diego, Calif., man. Launched from the ground automatically, the self-propelled rocket bomb would be guided in the air by the sound of the plane's motor. No matter how the pilot might twist and turn, the bomb would follow him until it overtook the plane. The impact would set off a charge of high explosive.

A model of such a bomb was recently exhibited to a POPULAR SCIENCE MONTHLY correspondent by Dr. Gustav Rasmus, San Diego patent attorney, who suggests this unique defense weapon. According to this inventor, he is secretly testing the possibilities of the plan with actual working models. If found practical, it would be used in the following way, he says:

For firing, the bomb is set in a mortar-like stand connected to sound detectors. The sound of an airplane passing overhead starts the bomb electrically. Its rocket motor enables it to travel fast enough to overtake the swiftest airplane.

In the air the bomb is guided by sensitive "ears" housed in knobs on the four guide vanes. They actuate rudder flaps. An impact on any one of five points detonates a charge of high explosive in the head of the bomb. Such a bomb, Dr. Rasmus says, could be made as large as desired.

MAT IN CAR PROTECTS WOMEN'S SHOES

TO PROTECT the heels and backs of women's shoes while driving a car, a wool fur mat with a rubber base is attached to the floor of the car with snap fasteners. It can be adjusted to any desired position, and removed for cleaning. It is said to reduce fatigue by giving the foot a support.

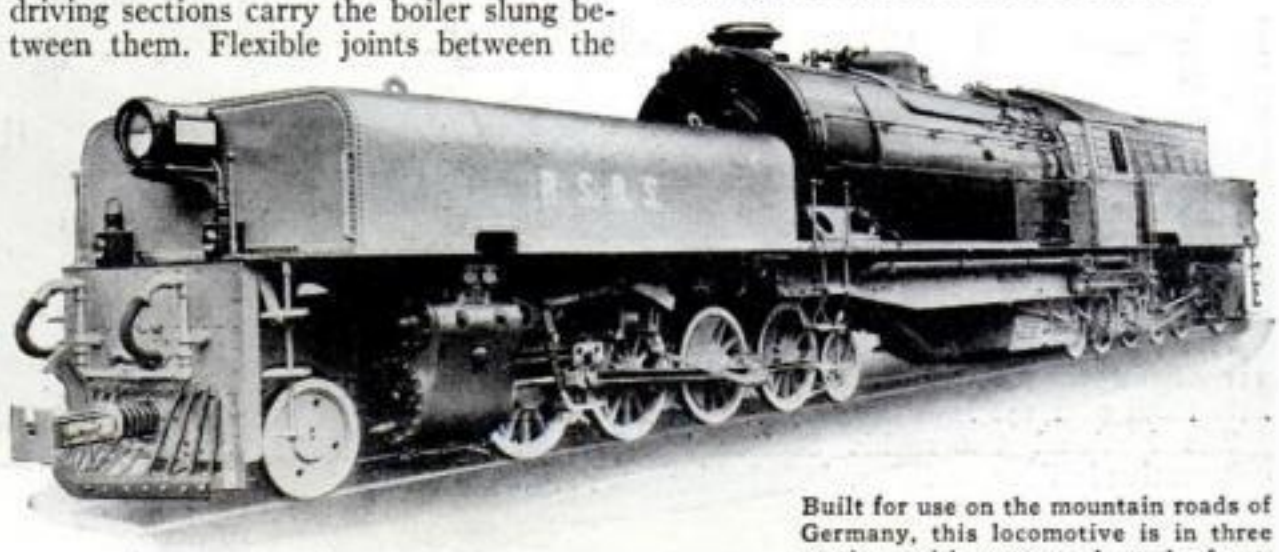
A mat of wool and fur, with a rubber base, is laid on car floor to protect the shoes of women drivers.

AUTOMATIC MACHINE TEES UP GOLF BALLS

A MACHINE that automatically tees golf balls has an oval container, holding several balls, to which a movable spout is attached. Depressing a short lever with a club end causes the spout to drop, depositing a ball on a rubber tee. When the ball is in position the spout swings out of way. It is used on practice driving ranges, both indoors and outdoors. Since it can be loaded once for fifty drives, there is no time lost in setting up balls for shots.

NEW LOCOMOTIVE IN THREE SECTIONS

A BOBSLED among locomotives is a jointed monster of the rails built recently in Germany for use on a mountain railroad. Two driving sections carry the boiler slung between them. Flexible joints between the driving sections enable it to pass around the sharp curves. Over the forward set of driving wheels, a water tank is carried.



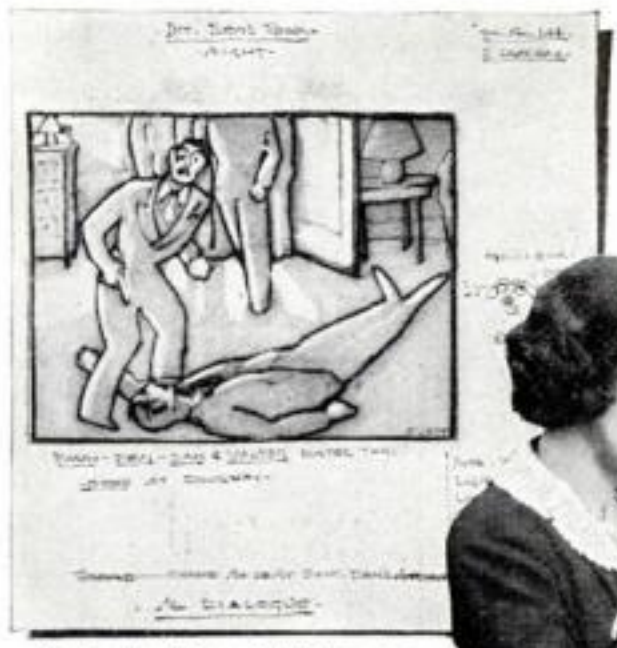
Built for use on the mountain roads of Germany, this locomotive is in three sections with water tank at the front.

NEW SCREEN FOR TALKIES MADE OF TINY SQUARES

A NEW screen designed for talking pictures is porous, allowing sound to pass through it. From a seat in a theater it looks like a smooth white sheet, but on closer inspection it is seen to resemble the texture of a woven cane seat in a chair.

It is made of myriads of tiny squares and rings of aluminum. At the corners of every square are four tiny "legs" that are clinched over the aluminum rings. This gives the screen flexibility and leaves many tiny holes through which sound can pass if the loudspeaker is placed behind the screen.

MOVIES NOW MADE FROM "BLUEPRINTS"



Elaborate "blueprints" are now made of each scene in a movie picture before it is "shot." Above is one of the sketches from which the directors and actors plan the enactment of scene.

Below, a director is explaining the use of the charcoal scene sketches which are now used in the movie-talkie studios of Hollywood.

MOTION picture directors now work from drawings when getting out a new picture. Before they start "shooting," a set of sketches showing each scene in detail is made. They show how actors will stand or be grouped against backgrounds and how lighting effects will be arranged. On the margin of each sketch are notes or diagrams showing the number and arrangements of cameras to be used.

Cameramen, directors, and actors study these drawings, known as "pictorial continuity," before going to work on the picture. When work starts, each one thus knows beforehand the requirements for each scene. Four hundred and twenty-eight of these drawings were made recently for a picture now under production in Hollywood.

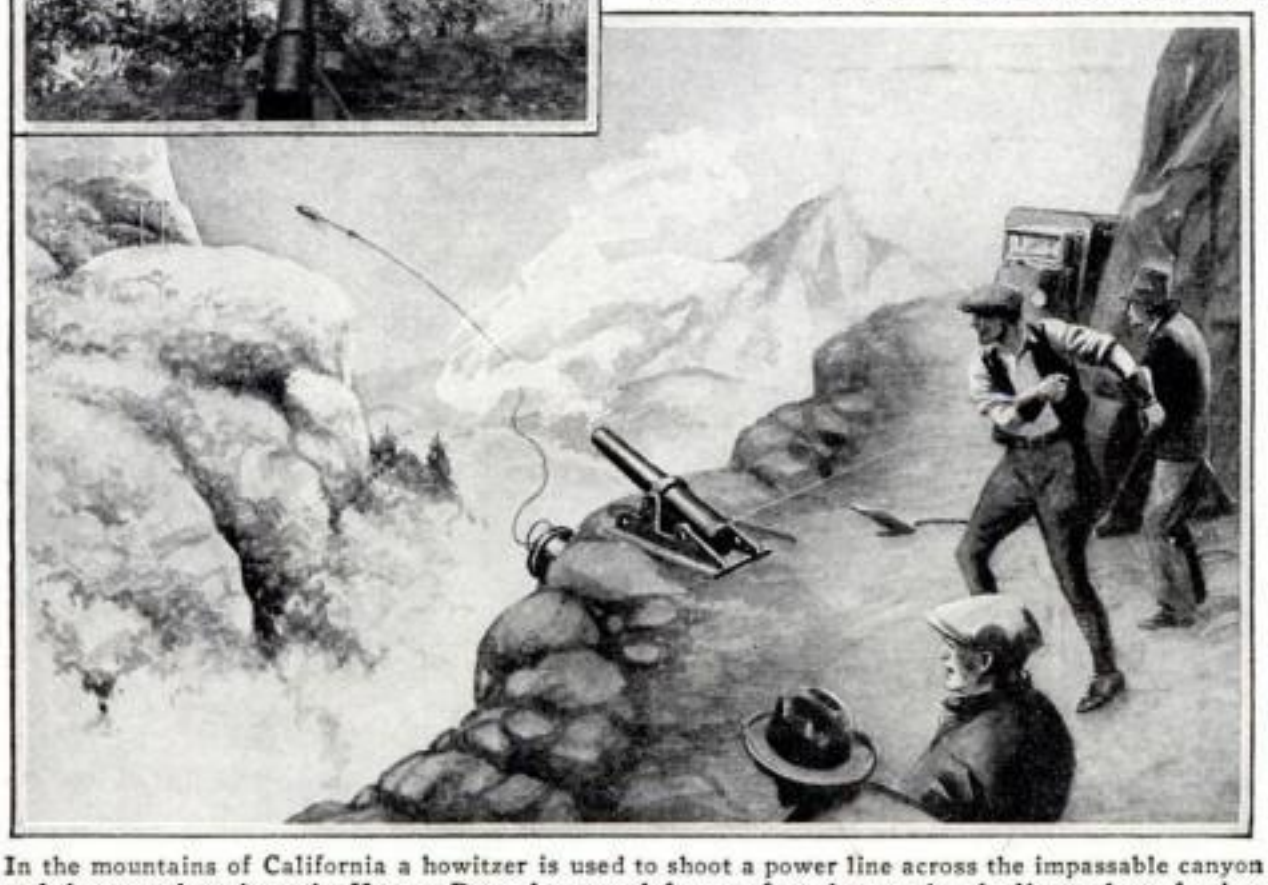
SHOOT POWER LINE ACROSS CANYON

A MARINE howitzer booms to help a western power company string electric transmission lines across the San Bernardino Mountains of California in record time. It shoots the line over impassable canyons, as far as 3,000 feet. Thus a wire is erected in a few minutes that would otherwise require days or weeks to put up.

The cannon fires a slug that carries a light rope to the other side of the gorge. Then the wire is attached to the rope and hauled across. With the howitzer's aid, the line is carried over all the intervening brush and all but the tallest trees.

In shooting across the canyon, pictured in the photo at the left, the projectile was carried in a perfect line to a spot on the bank at the base of the poles, visible in the picture as thin white lines.

This method was devised to speed the erection of the power line that will supply electricity to the builders of Hoover Dam, at Boulder Canyon on the Colorado River.



In the mountains of California a howitzer is used to shoot a power line across the impassable canyon and thus speed work on the Hoover Dam. At upper left, a perfect shot carries the line to foot of poles.

RUBBER LEAF IN RAZOR IS SHOCK ABSORBER

A LITTLE "shock absorber" robs shaving of some of its discomforts. It is a leaf of rubber used on razors in which the blade clamps between two holders. The leaf is placed between blade and holder before the razor is screwed together. It causes the blade to give as it passes stiff bristles. This results in a drawing cut similar to that used by good barbers.

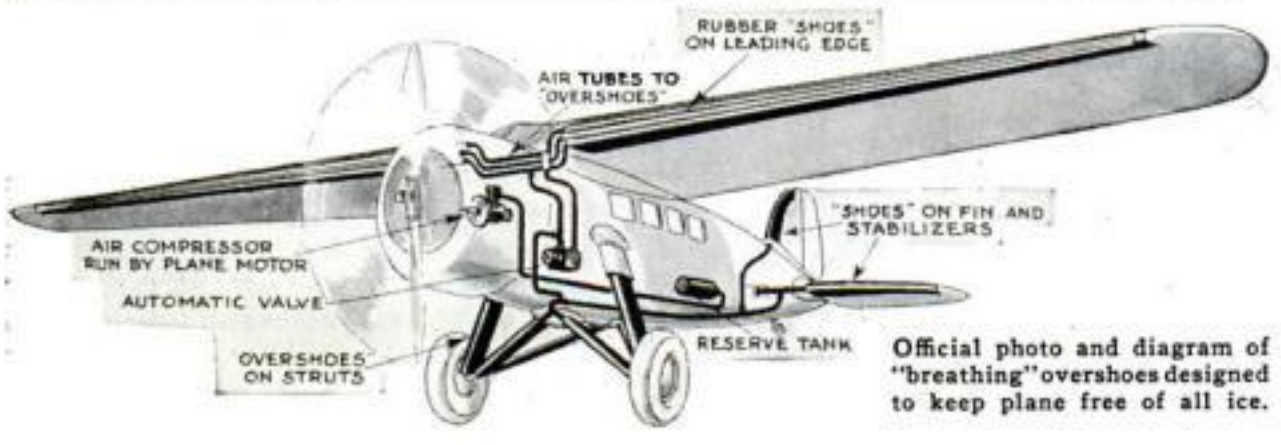
SCIENTIFIC TOY AIDS ADVERTISING STUNT

A PLAYTHING of high school science classes, the "Newton color disk," inspired a Beaumont, Texas, man to invent a new advertising device. Thousands of color combinations appear and vanish on a whirling, motor-driven disk, across which moves an endless belt spotted with colors. At intervals an advertisement, a package of cigarettes, a picture of a girl, or words appears in a hole at the disk's center.

OVERSHOES FOR PLANE END ICE DANGER

RUBBER "overshoes" for a plane's wing and control surfaces recently passed their final test at Akron, O. An airplane equipped with these devices flew through freezing mist at altitudes of 2,000 to 3,000 feet, and shook off the ice as fast as it formed.

The official photograph and diagram reproduced here show how the devices work. Hollow rubber strips are fastened to the leading edge of the plane's wing and to its tail fins. When the plane encounters icy mist, the tubes are inflated and deflated by an air compressor and an automatic valve operated from the plane's engine. As ice forms, it cracks and falls from the wing.

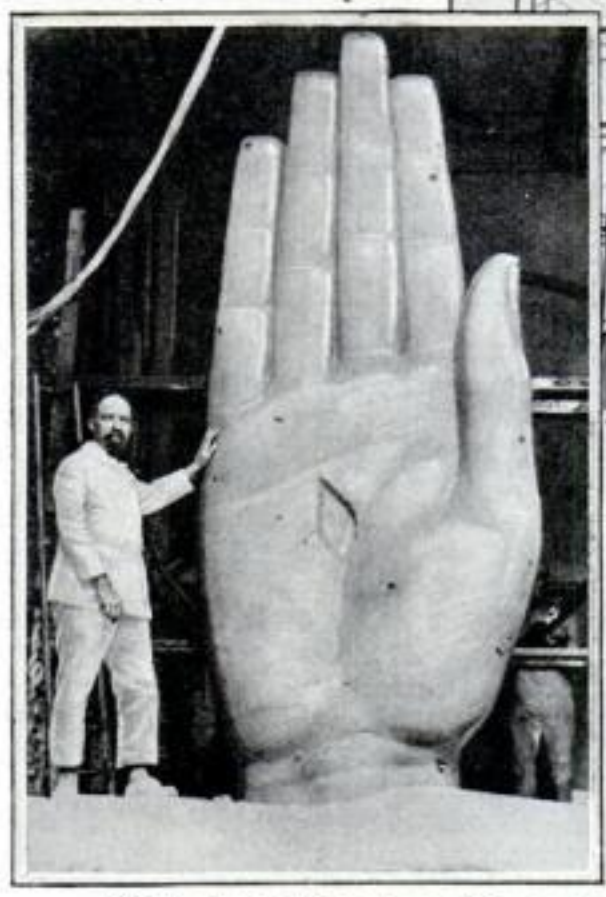


Official photo and diagram of "breathing" overshoes designed to keep plane free of all ice.

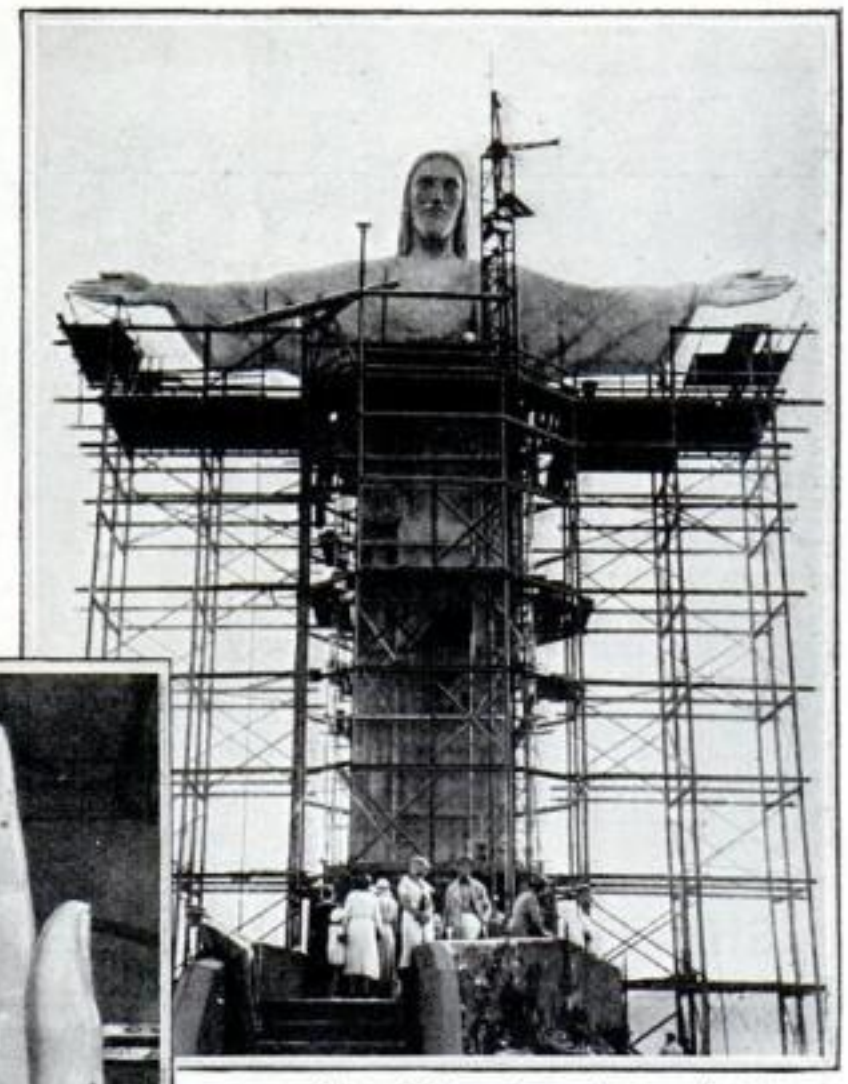
BIG FIGURE OF CHRIST GUIDES SAILORS

A GIGANTIC figure of Christ, comparable in size to America's Statue of Liberty, is receiving its finishing touches in Brazil. Covered with blue-green tile, it rises 150 feet above the summit of Corcovado Mountain on the seacoast of Brazil.

Work was started on the statue in 1927. The hands, twice as tall as a man, were completed first (P. S. M., Sept., '27, p. 13). Beneath the colored tile surface of the statue is a supporting core of reinforced concrete. The statue was designed by Paul Landowski, Parisian sculptor.



This twelve-foot hand spreads in a gesture of benediction on the gigantic figure of Christ that stands on Brazil's coast.

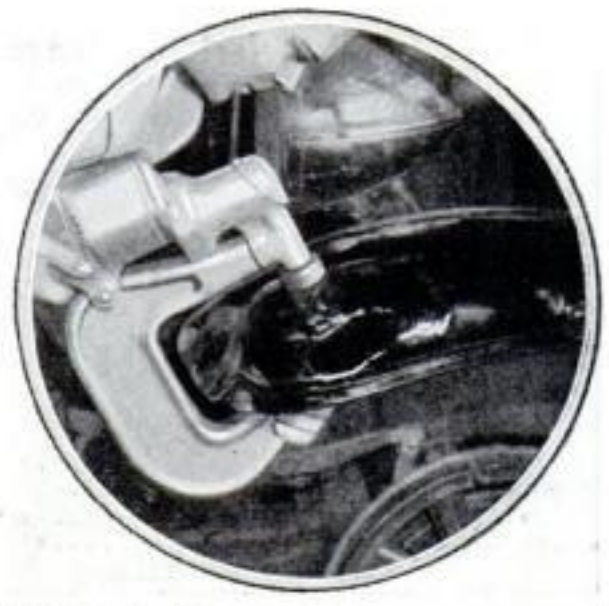


Rising 150 feet above the summit of Corcovado Mountain, Brazil, this statue of Christ guides sailors.

NEW ELECTRIC MACHINE REPAIRS CAR FENDERS

IF THE fenders of your car are dented, they speedily regain their graceful curves under the massaging of a new electric fender straightener. Its motor drives an eccentric that applies a ton's pressure to the fender, 1,400 times a second, through dies mounted in its jaws.

With each instrument comes a complete set of dies of various shapes, some more rounded than others, and some flat. A pair is chosen to suit the particular shape of the part of the fender undergoing repairs. One set even puts the border line or "bead" back in the dented fender. Another smooths the fender at spots directly over a brace, in a cramped position where a hammer could not be used. With the aid of this tool, it is said, a novice at car repairing can do a job equalling that of many an expert.



This electric-driven machine, with various shaped dies, is used to straighten a car's bent fenders.

CAR SEAT FOLDS BACK TO MAKE LOUNGE

Folding back against the rear cushion, this front seat makes a lounge upon which the tourist can pass a comfortable night.

OVERNIGHT comfort for auto tourists is provided in a recent body style supplied with a popular make of light motor car. The back rest of the front seat folds back until it connects with the rear seat, making a comfortable bed or lounge. This novel body design is expected to prove a convenience to motorists who have to make long drives through regions where hotel accommodations or tourist camps are scarce.

It can also be used by an invalid who needs a daily ride, and in an emergency would serve as an ambulance in rushing an injured person to the hospital.

ZEPPELIN CAR HITS 150 MILE SPEED ON RAILS

WHEN the "Zeppelin car" of the German engineer Franz Kruckenberg recently sped at 150 miles an hour along a Hanover railway, it set a new record for air-propelled vehicles on rails.

The Zeppelin car resembles an eighty-five foot blimp, set on the undercarriage of a railway coach. In its first trial (P.S.M., Jan.,'31, p. 31), its airplane propeller drove it at 114 miles an hour. The streamlined car seats fifty persons, and is expected to enable railroads to compete with airplane travel.

ACADEMY OF SCIENCES HONORS ASTRONOMER

A FAMOUS astronomer of California received signal honors when the National Academy of Sciences recently chose Dr. William Wallace Campbell, director of the Lick Observatory, to be its new president.

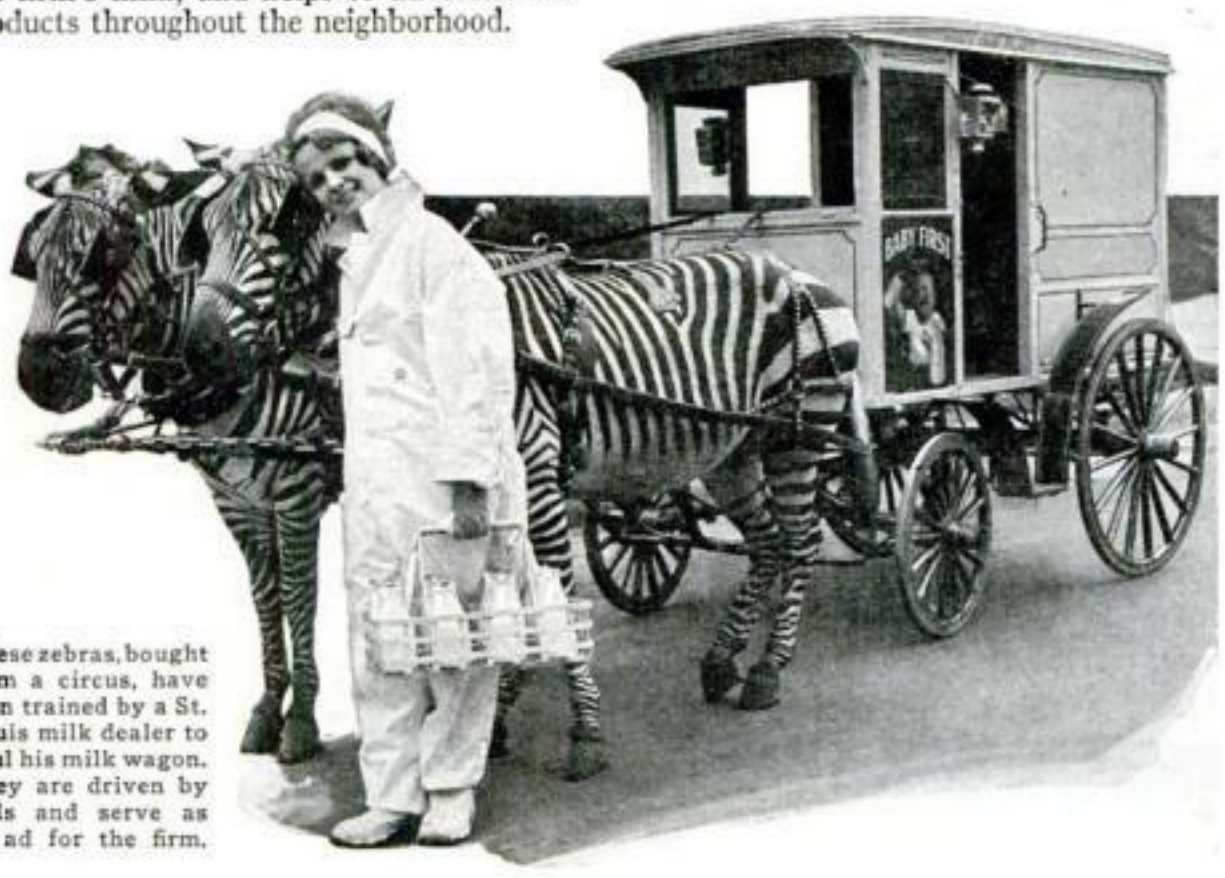
Noted for his studies of the stars with the spectroscope and his observations of eclipses of the sun, Dr. Campbell was president of the University of California until he retired recently, to return to active astronomical research. He is also a member of the Committee of Award which selects the recipient of POPULAR SCIENCE MONTHLY'S $10,000 annual award for achievement in science.

PLAN "SOUTHPAW" BOOKS

Now comes the left-handed book for "southpaw" readers. Recently the French Minister of Public Instruction suggested to Paris publishers that they issue a special edition of each new book, with page one at the back. The readers would progress toward the front of the book.

ZEBRAS USED TO HAUL ST. LOUIS MILK WAGON

ZEBRAS draw a milk wagon on a regular St. Louis, Mo., delivery route. A pair of the animals were recently imported after their purchase from a German circus. The milk concern trained them to wear harness and pull a wagon just as horses formerly did. Comely milkmaids drive them and deliver the bottles to the customers along the route. The novelty appeals to buyers of the firm's milk, and helps to advertise its products throughout the neighborhood.



These zebras, bought from a circus, have been trained by a St. Louis milk dealer to haul his milk wagon. They are driven by girls and serve as an ad for the firm.

WORKMEN LIKE ANTS ON PLANETARIUM'S DOME

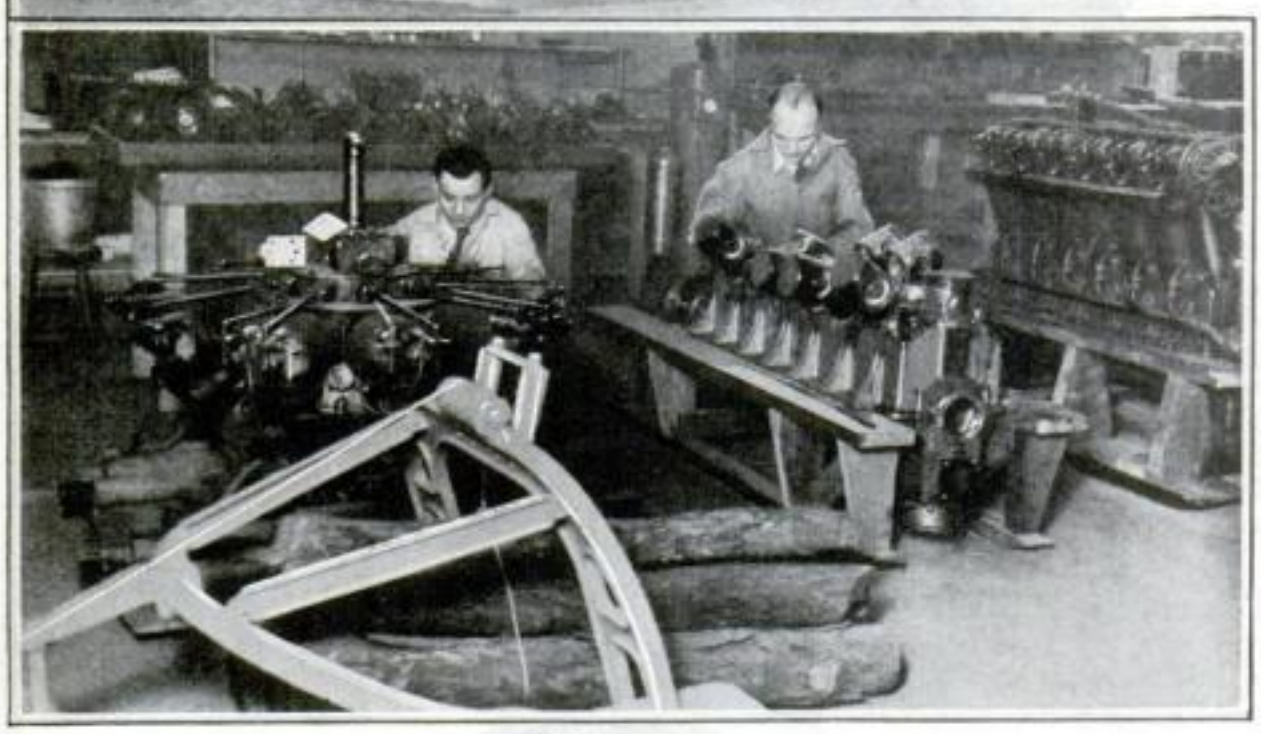
LIKE ants crawling over a golf ball, workmen swarm over the framework of a planetarium, or working model of the heavens, now under construction in Germany. This unusual view shows them putting the finishing touches on the metal openwork which will eventually support a plaster dome, to represent the sky. Artificial stars and planets will be made to move in their orbits by projecting spots of light from the interior upon the darkened dome. The photograph of a planetarium under construction is of particular interest, since the recent erection of a similar animated model of celestial movements in Chicago. Planetariums are also planned for other American cities as the best means of teaching the public what it really sees when watching the sun and stars.

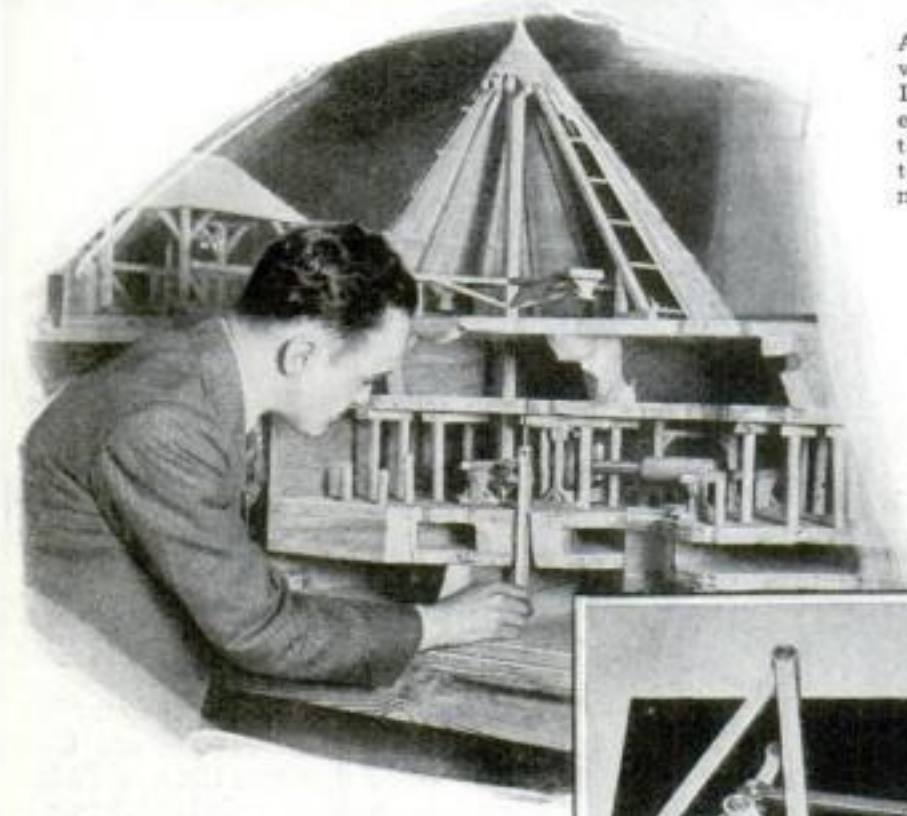
USE LAWN MOWER TRUCK TO TRANSPORT RADIUM

IT LOOKS like a lawn mower—but a little two-wheeled truck at New York City's Memorial Hospital, where the world's largest single store of radium is kept, has a far more unusual task than to cut grass. It enables attendants to wheel radioactive "seeds" from room to room without fear of burns. The rays from tiny tubes of radium make the capsules too powerful to be carried by hand. They are withdrawn from the truck with tongs to treat cancer.

World's Machines in One Museum

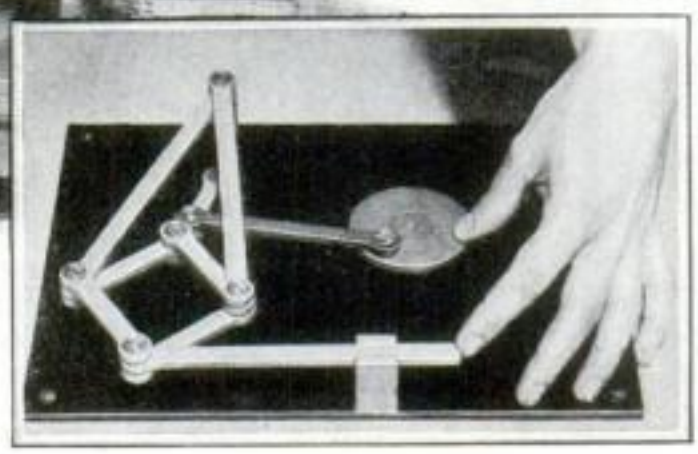
The Rosenwald Museum of Science and Industry, Chicago, once Fine Arts Building.





Above, the Wright Whirlwind motor, left, and the Liberty motor, right, will each be sliced in half so that the finished product will run to show every working movement of these plane motors.

At left, a model of a typical mine and tipple of the fourteenth century. Other exhibits will show how England became dependent on coal for its fuel supply.



Simple working models, like the one at the right, which shows how rotary motion is changed into vertical motion, will tell the student more about fundamental mechanical principles than he could acquire in hours from a textbook.

JULIUS ROSENWALD, Chicago multimillionaire, stood before a small group of the city's leading business men five years ago and proposed a museum unique in America.

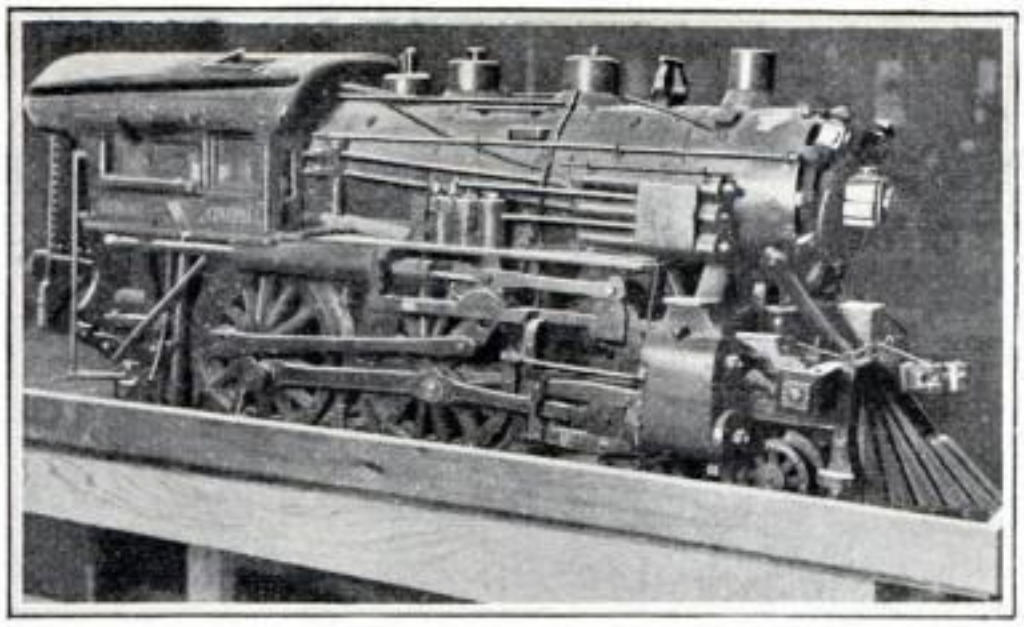
Instead of stuffed animals or paintings, its exhibits would be machines. They would all work. Visitors would be invited to push buttons, pull levers, and see what made the wheels go around in everything from doorbells to steam turbines. Germany had built such a museum, and he said he would contribute $3,000,000 (a sum later increased to $5,000,000) to duplicate, or surpass it, in America.

Now that plan has come true. At this writing, scores of artists, wood carvers, machinists, and electricians are at work building a series of exhibits that will be worth $30,000,000 when completed. Some, already finished, are illustrated on these pages. When they are all installed, the Rosenwald Museum of Science and Industry at Chicago will go far beyond the scope of industrial museums that Berlin, Paris, and London now possess. It will show not only machines in motion, but the whole drama of social and economic change that has always come in the wake of a great invention.

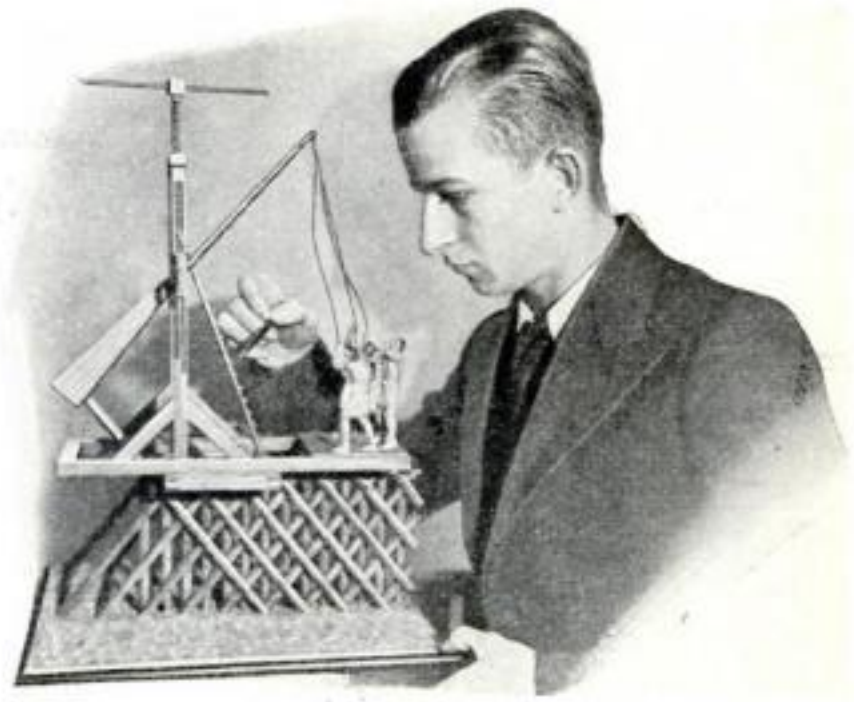
In one painted model 500 horses struggle hopelessly at the pumps to stem rising waters in an English coal mine. Near-by stand smithies idle and homes unwarmed for lack of fuel. A label explains that by the early 1700's, most of England's coal mines were "drowned." To the rescue came two engineers, Newcomen and Savery, with their invention of the steam pump, and the day was saved. That was the immediate parent of James Watt's epoch-making steam engine.

Because of space limits, the museum employs ingenious artifices to tell its complete stories. A railroad car is divided in sections, according to period. Seated in the first, you will be shaken by hidden machinery as passengers were bumped by crudely-laid rails ninety years ago. The last compartment is that of a modern smoothly running Pullman sleeper.

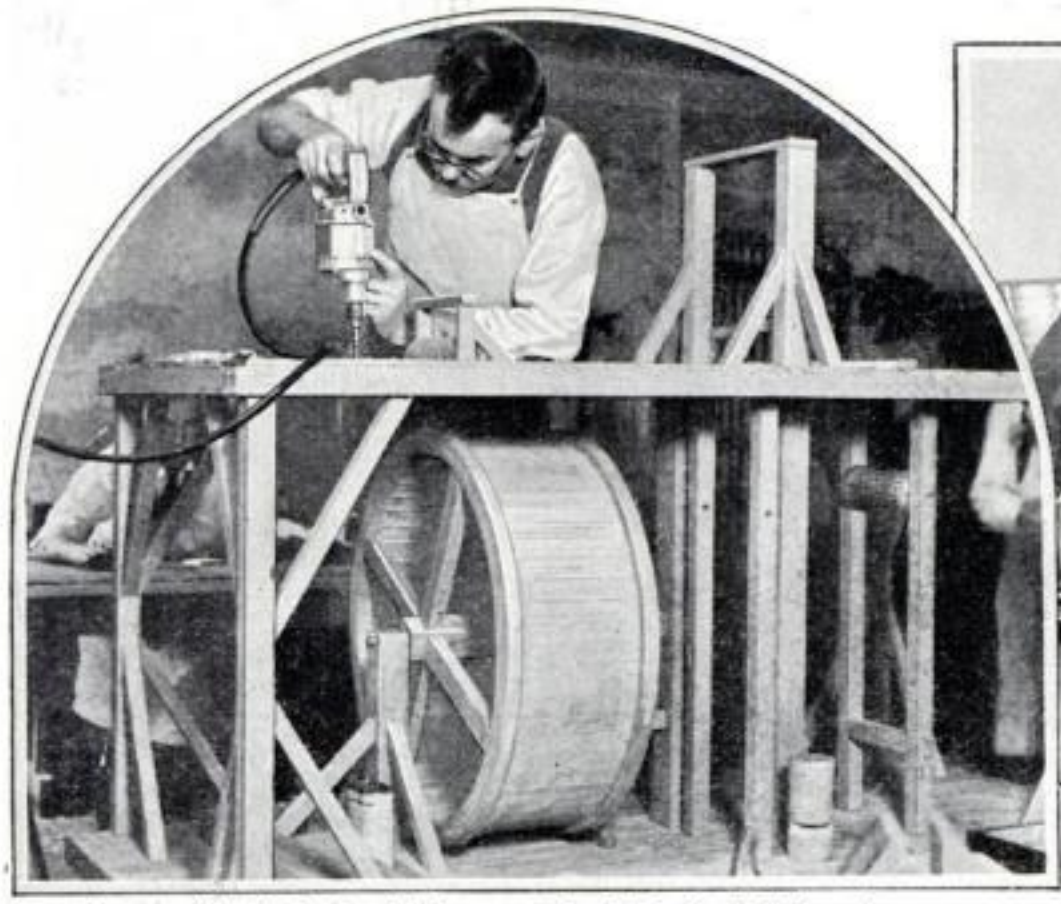
One room of the museum will be a "news" exhibit of the latest scientific discoveries and future projects.



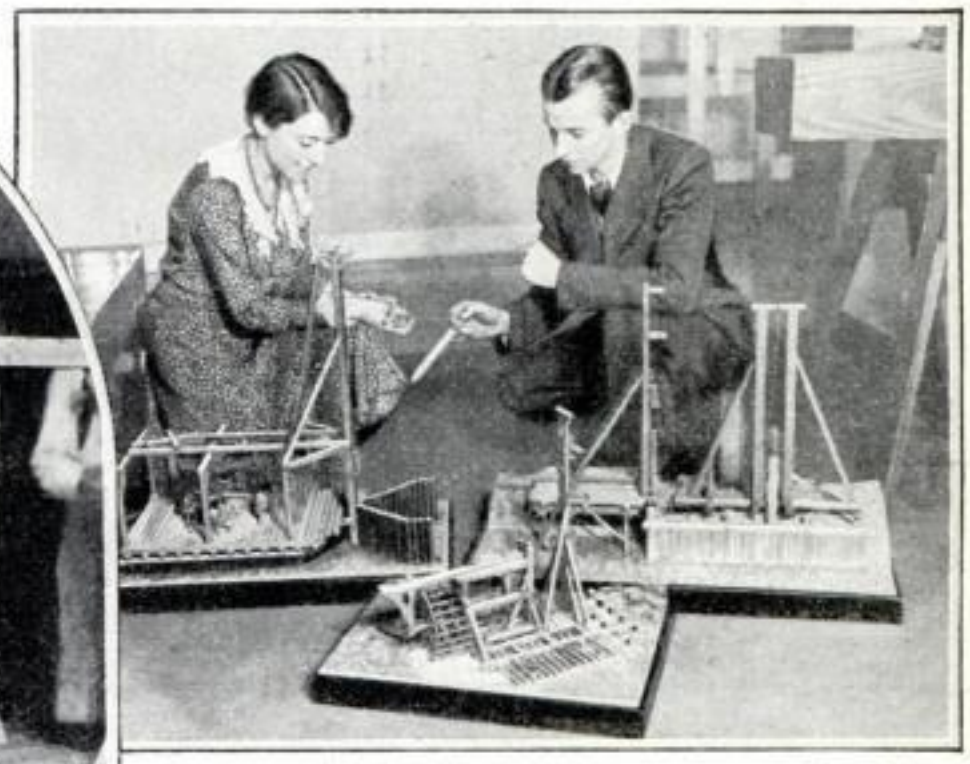
Model of an early Illinois Central railway locomotive presented to the museum by that line. This is one of a series of models that will depict the growth of transportation. Another exhibit shows a railway car divided into sections, each representing a period in railroad history.



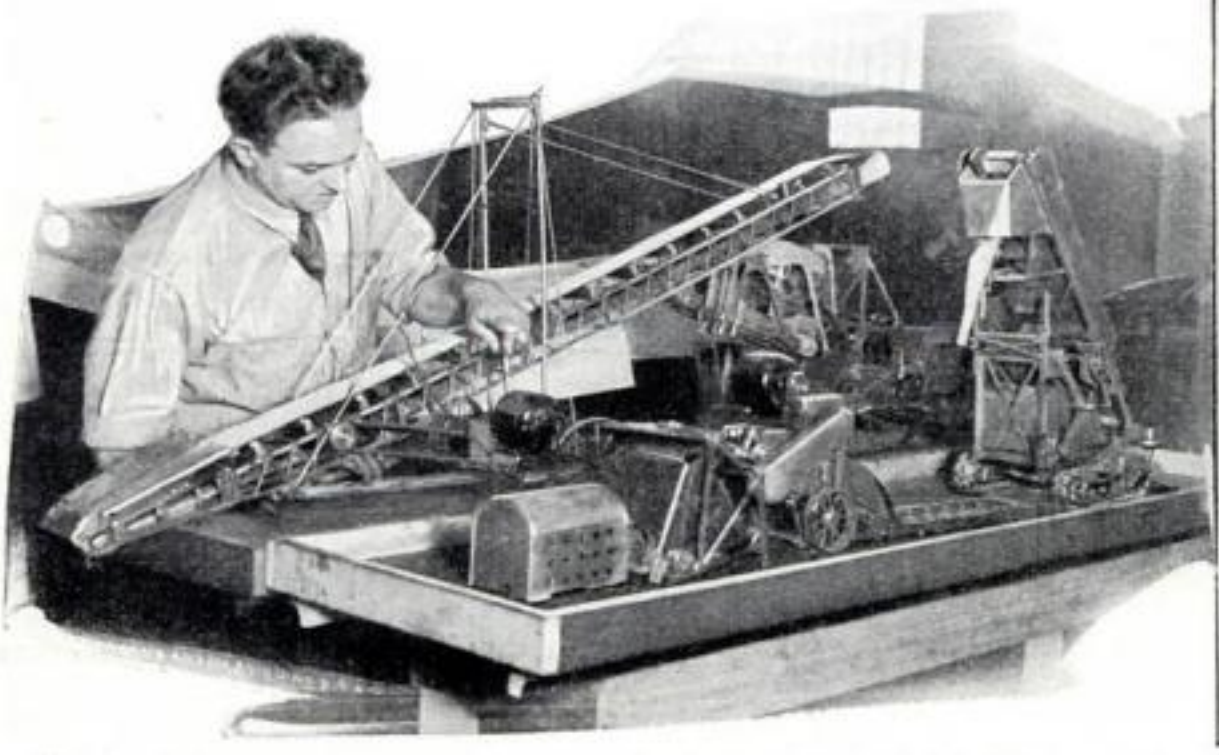
Hand carved figures show how hard men had to work to run this Roman pile driver. Other exhibits use motion pictures to show how ancient men lived and how their machines worked.



An early sawmill with its inevitable water wheel is being built for the museum to illustrate one step in the advance of industry to new forms of power. Other models will tell the story of man's use of horses, wind, steam, and electricity.

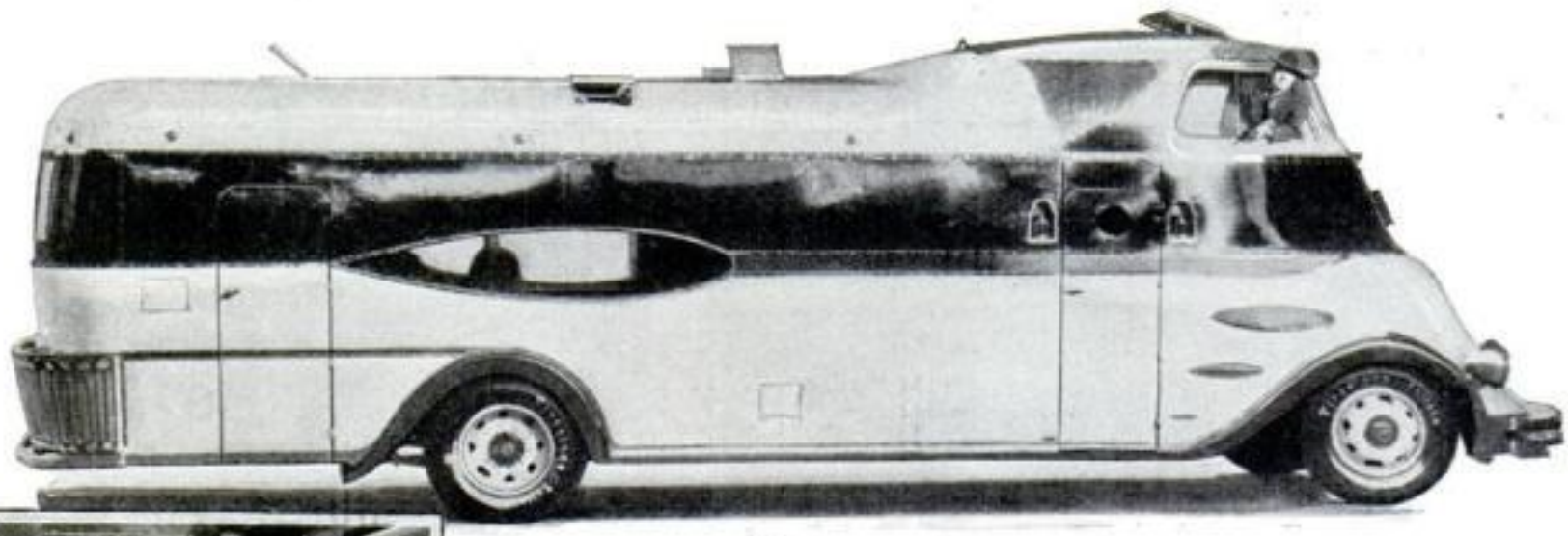


Another model of a pile driver reveals the surprising fact that these machines were once worked by water wheels.



Here is what you see when you watch a steam shovel at work in a city lot. It is an exact reproduction, built to scale, of modern excavating and loading machinery. It is a working model that does in a small way exactly what the big fellows do on outdoor jobs.

In the picture the young woman is holding a model of Leeuwenhoek's original microscope and comparing it with a modern one with many lenses.



At top, the strange looking vehicle is a complete movie theater on wheels run by its own power and meant to visit small western towns. Above, within the projection room; at right, one of the pullman berths. An automatic sprinkler system has been installed to protect the projector operator.

Monster Bus Is Equipped to Serve As Traveling Movie Theater

A BLACK and silver thirty-four-foot juggernaut of the road, just completed in California, will bring talking movies to country dwellers, in towns too small to boast theaters of their own. The huge bus carries a complete talkie theater in its spacious interior. When the bus is drawn up at the side of a road and two doors at the rear are opened, a screen is disclosed. An audience of 2,000 can see and hear the pictures that are projected upon it from inside the bus.

Elaborate living accommodations will make its crew of six comfortable during a projected tour of the United States. Pullmanlike berths, a shower bath, and a complete kitchen with a refrigerator and an electric hot water heater are among its fixtures. The driver's "pilot house" is on a second level above the "engine room," and is reached by a stairway.

Under the screen at the rear of this land cruiser are the huge horns that supply sound for the talkies. They are fed with electricity from a built-in gasoline-powered dynamo. The projection room is guarded against fire by automatic sprinklers.

ELEVEN BLIND MEN RIDE ONE BIG CYCLE

AN ODD-LOOKING cycle that seemed to have some of the qualities of a railway train was seen on the roads near Upper Norwood, England, the other day. Its twelve riders pedaled along, seated in flexibly connected units of the "multicycle." This centipede among vehicles is twenty-eight feet long, but its flexible connections enable it to turn corners easily. It was built for use by students at the Royal Normal College for the Blind. An attendant with normal vision steers it.

STAR IS "SKY SIGN"

THE "electric sign of the sky" is a newly-discovered star that flashes every 100 minutes. It fluctuates in brightness faster than any variable star known.

On this elongated cycle, built for the students of the Royal Normal College for the Blind, Upper Norwood, England, eleven of the sightless victims can ride guided by one rider who can see.

AMERICA HAS NINETEEN WORLD AIR RECORDS

THIRD place in the list of nations holding the 105 air records recognized by the International Aeronautical Federation is occupied by the United States with nineteen records. France is first with thirty-eight, Germany second with thirty, Italy fourth with eight, Great Britain, Spain, and Czechoslovakia fifth with three each, and Hungary holds one. France will make a determined effort to add the world air speed record to her laurels this year when she competes for the Schneider Cup.

MOON WEAKENS RADIO

IF BROADCASTING stations come in poorly at night, blame it on the moon. Moonlight, like sunlight, interferes with radio reception, it was discovered recently. Dr. Harlan T. Stetson, of Ohio State University, found signals between Chicago and Boston a hundred percent better when the moon set. A negative electrical charge on the moon is thought responsible.

FOUR TOOLS COMBINED IN ONE INSTRUMENT

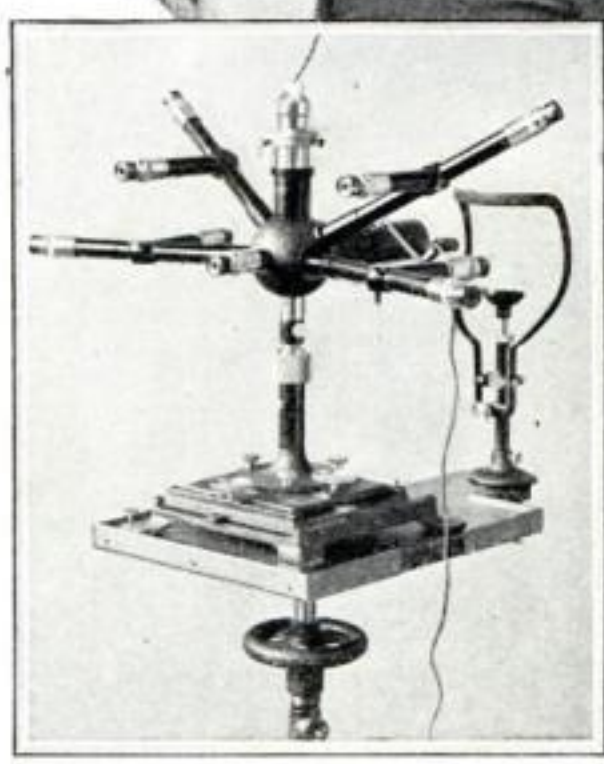
FOUR tools are combined in this handy little instrument for the draftsman. Its tapered point lifts thumb tacks from the drawing board, saving wear and tear on his finger nails. A fine file on one side of the shank shapes pencil points, and a coarse file on the reverse side cleans erasers. The tool is magnetized so that it can be used to lift thumb tacks out of the box.

BIG TRUCKS THAT CLEAN STREETS, FIGHT FIRES

TANK trucks in the street cleaning department of Seattle, Wash., are general all-around vehicles. They clean streets by flushing them with water pumped from their 1,200-gallon tanks as they roll along at about fourteen miles an hour. Is any one's cellar flooded? A telephone call brings one of the street cleaning tank trucks, to pump the water out into its tanks and carry it away.

Since they patrol the city streets all day, these trucks frequently find themselves at the scene of fires before the engines arrive. In that case they connect hoses to their pumps and in a few minutes have two streams of water on the blaze.

NINE PEOPLE AT ONCE LOOK IN ONE EYE



Multiple eyepieces on this microscope enable nine persons to examine one eye, as shown in photo at top, while doctor lectures on it.

STRANGEST of optical instruments is the one invented by a German eye doctor recently to permit himself and eight students to look into one human eye through a microscope at the same time while he explains its functions. A system of eyepieces and reflecting lenses like those in periscopes enables doctor and students to view the marvels of the human eye as magnified by a powerful microscope. The lens through which the subject looks is adjustable and an electric light in the apparatus permits the reaction of his eye to different conditions of lighting and focus to be studied.

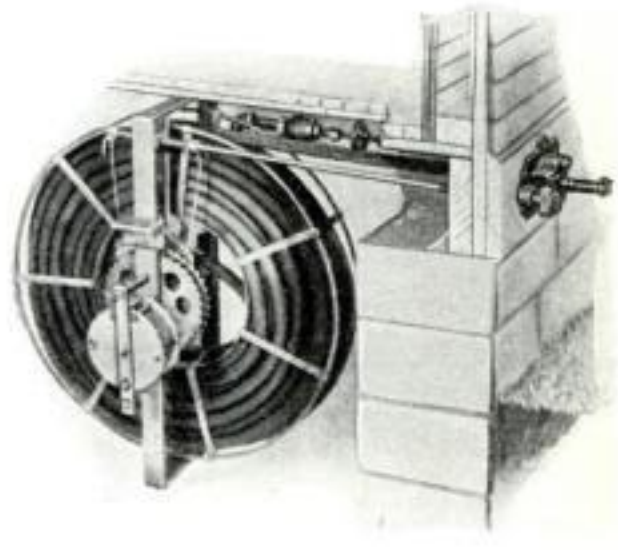
An adjustable face frame and chin rest hold the head of the person being examined in a steady position.

DYNAMITE BLASTS PUT ROAD IN PLACE

DYNAMITE charges blast a road into place in a startling new process. Formerly when a road was laid across a swamp or soft land, five or ten years sometimes elapsed before the filled-in material settled sufficiently for a permanent pavement to be laid. Now a road over treacherous ground may be paved in months or within the year. The required "fill" is piled high on top of the marsh, studded with charges of dynamite. Explosion of the charges pushes the underlying muck to the sides and the fill settles immediately into place, making a firm footing.

Placing a charge of dynamite in the new process that blasts road material into place over swampy land.

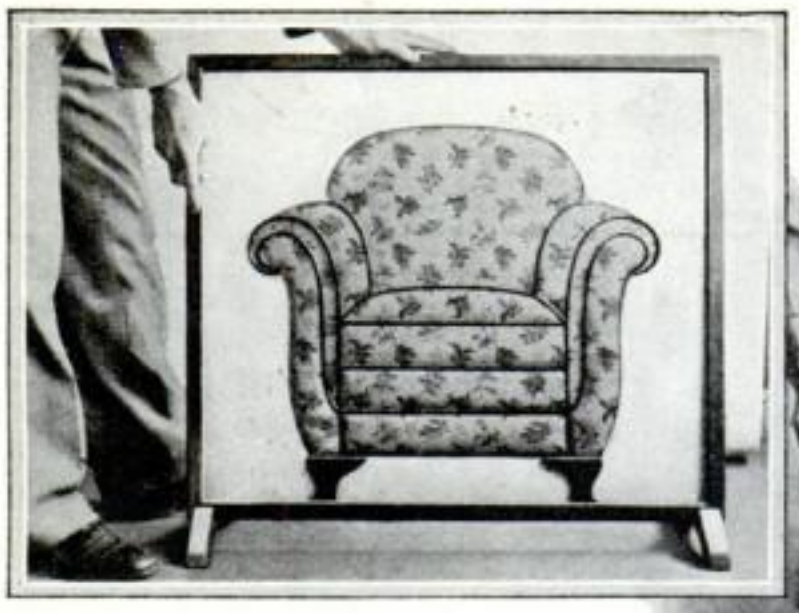
At left, boxes covering the planted charges of dynamite, which, after road material is piled on top, are exploded to get enduring foundation.



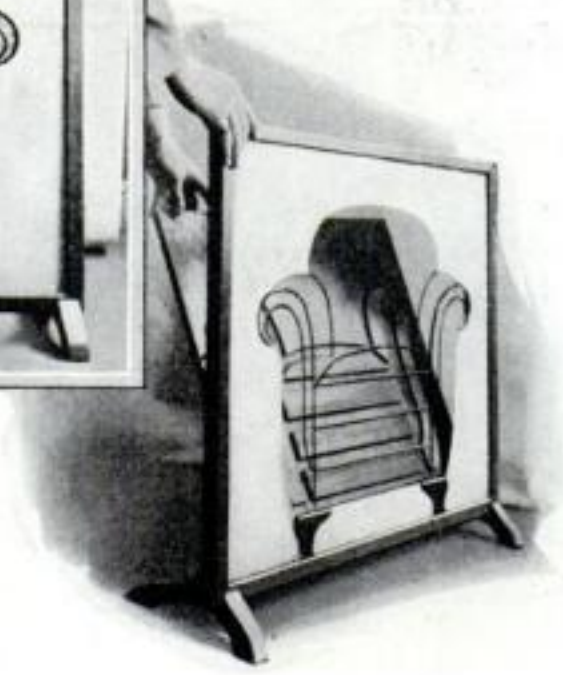
BUILT-IN HOSE REEL WINDS ITSELF UP

WHEN your lawn needs sprinkling, it is a simple matter to spray it with the aid of a new built-in hose reel. Permanently installed in the basement and connected to the water supply system, it eliminates the need of fussing with a heavy coil of kinky hose.

The nozzle is held within easy reach, outside the house. A turn of a key unlocks the reel and turns on the water, and a gentle pull unreels any desired length of hose. After use, the key is turned again. Automatically a spring winds up the hose, locks it, and shuts off the water.



Below, opening the panel in order to place fabric over frame; and, at left, the frame with cloth held in place by heavy wires so appearance of re-covered chair can be seen.



FRAME SHOWS HOW CHAIR, RE-COVERED, WILL LOOK

A NEW dress for the old chair is easily visualized with the help of this frame. Its center panel, which is detachable, is cut and sunk in the relief semblance of an upholstered chair. All that is necessary is to unfasten this panel at the top, lay over it a piece of upholstery material, and fasten it into place again. Heavy wires hold the material closely in the depressions of the relief. By this means the housewife may almost see her own chair complete before she makes her choice.

BIG COPS NO STRONGER THAN LITTLE FELLOWS

DO BIG men make good policemen? W. Leonard Johnson, physical examiner for the New Jersey Civil Service Commission, finds that size requirements for policemen are based on the belief that big men are strong. By tests on 450 applicants for police positions, he found that size bore no relation to strength in men over five feet six inches tall.

Further tests revealed that up to 165 pounds, weight bore some relation to strength, but above that none. He said these facts showed that physical requirements for patrolmen needed revision, as size alone does not indicate efficiency.

YOUR HAND LAWN MOWER NOW RUN BY POWER

A LABOR-SAVING device for home gardeners is a new power drive attachment that can easily be used with any standard type of hand lawn mower. The motor and driving mechanism are mounted as a complete unit on the handle. A cross shaft with two rollers turns the mower's wheels by friction. The whole apparatus is clamped in place with a few bolts.

Either gasoline or electric drive can be supplied. A small electric motor takes its current from a cord that is drawn behind the machine in the same manner as the cord on a vacuum sweeper. This drive is used chiefly for small lawns. On larger lawns a two-cycle gasoline engine pushes the mower. It will run for eight hours on one gallon of gasoline. The electric drive weighs forty-eight pounds and the gasoline drive weighs fifty-four pounds.

Attachment clamped to handle of lawn mower gives power to run any standard machine. Notice the two rollers, mounted on cross shaft, that turn the mower's wheels by friction.

KENTUCKY HOME HAS FIREPLACE OUTSIDE

AN OUTDOOR fireplace aids a Kentucky home owner and his family to enjoy fresh air and sunshine during early spring and fall days when the air is inclined to be a bit chilly. The unique fireplace is built into the chimney of the house, facing out onto a wide porch. Fresh air and warmth are thus obtained.

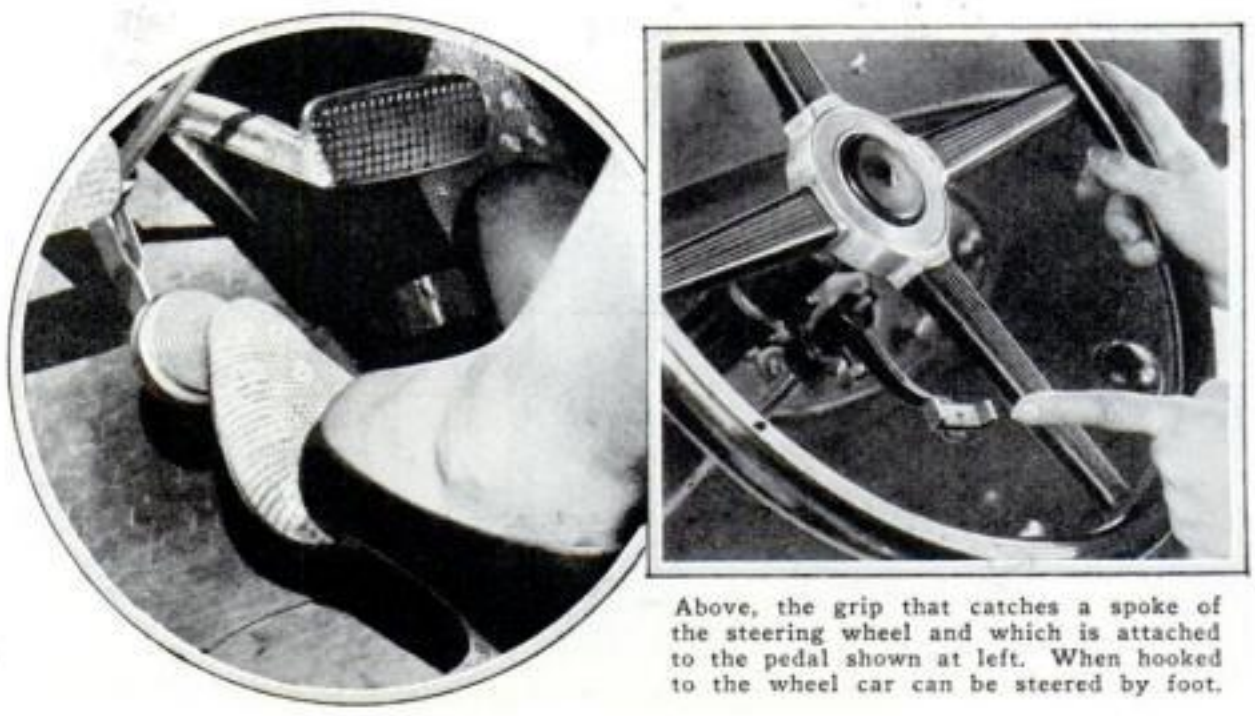
YACHT'S HULL CONCRETE

OBSERVERS at Stockholm, Sweden, recently noticed a small white yacht sailing about the harbor. Her hull seemed a dead white shade, without gloss or luster. It was made of concrete less than half an inch thick. This is believed to be the first use of such material in a small yacht, though during the war larger boats used it.

PEDAL LETS YOU STEER CAR BY FOOT

A DEVICE recently placed on the market by a Los Angeles, Calif., manufacturing firm enables auto drivers to steer by foot pressure for short distances. Pressing a foot pedal causes an arm to spring up and engage a spoke of the steering wheel. Then the car can be guided by a side-to-side movement of the pedal.

This novel method of steering cannot be used where there are sharp curves to round. It is designed for open roads, when the driver wishes to light a cigarette, for example. A car can be steered only for a limited distance from one side to the other by it—enough to keep it going in a straight line or on a gently-curving road. The foot pedal extends out from the steering column, between the clutch and brake.



Above, the grip that catches a spoke of the steering wheel and which is attached to the pedal shown at left. When hooked to the wheel car can be steered by foot.

LAST UNITED STATES VOLCANO DEAD

Above, Mount Lassen, California, in last eruption. At upper right, old lava flow; and at right, geologists examining big vent.

MOUNT Lassen, in northern California, last volcano in the United States, will never erupt again, according to the results of a study of more than a year by R. H. Finch and C. A. Anderson, of the geological department of the University of California. These investigators discovered that Mount Lassen's activities probably extended back to A.D. 500. Once, they found, it covered an area of several craters and that at least five times it has flooded northern California with lava, the latest occurring about 1849.

Lassen's last activity was in 1914, when smoke and hot cinders were thrown out, but no lava. The lava beds around Lassen cover hundreds of square miles and are perforated at frequent intervals with caverns of large size and great length, many of which have not been explored. Rivers flow from at least two of these caves, while smaller "wet-weather" streams gush from others. These lava beds are the wildest part of California.

USE BICYCLE FRAME TO REEL UP WIRE

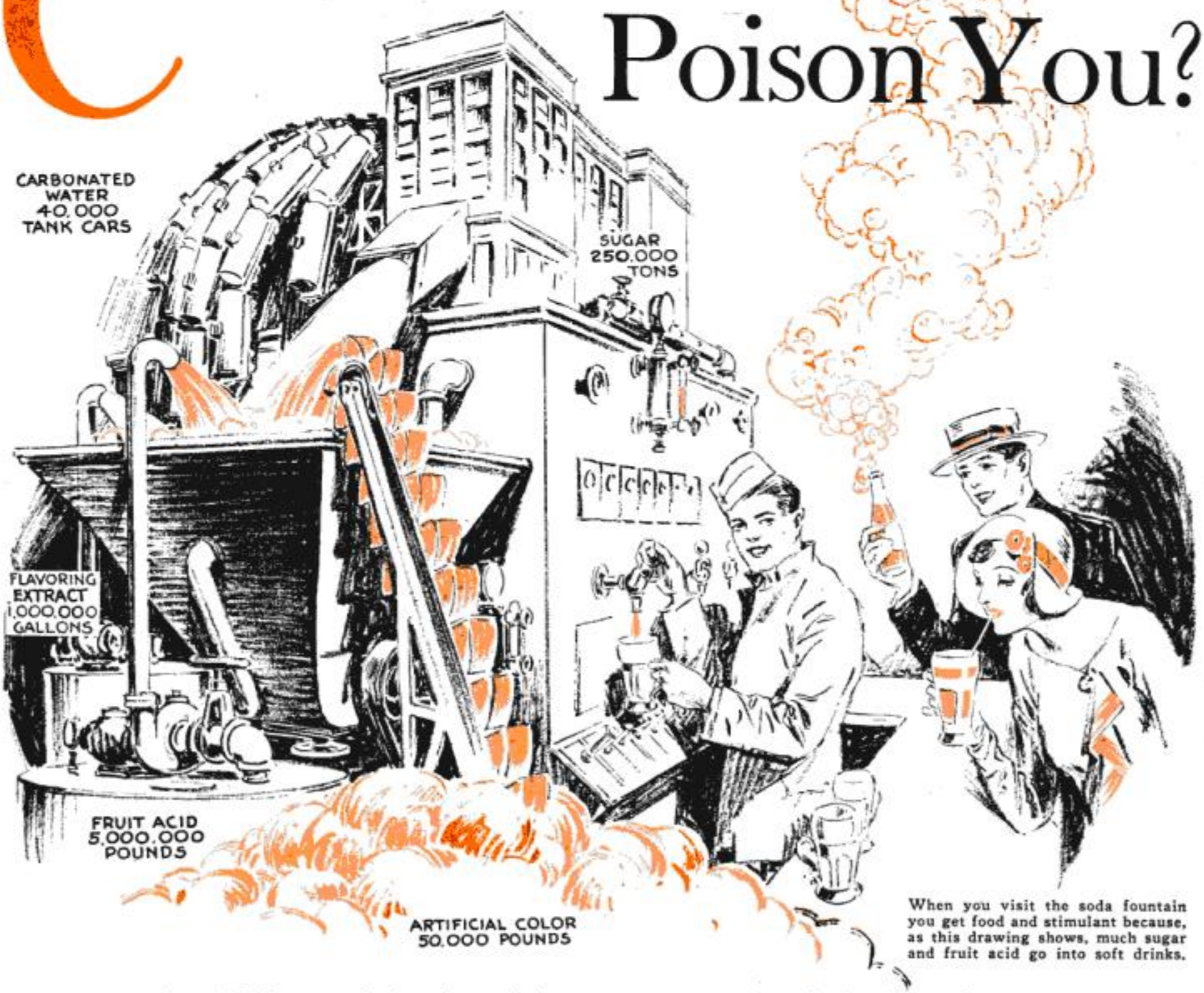
Pedaling an old bicycle frame, a member of U. S. Signal Corps in Texas reels up telephone wire.

AS AN aid in reeling up field telephone wires, signal men of the United States Army at Fort Sam Houston, Texas, have rigged up the frame of a bicycle on a motor truck. The frame is fitted with pedals and saddle and connected by sprocket and chain to axles on which the wire reels are mounted. Seated on it and pedaling as he would on an ordinary bicycle, one man reels up the wire while another guides it on the drums.

ANY ESKIMO HOME IS CALLED "IGLOO"

MANY textbook writers and movie directors think that "igloo" is the Eskimo term for "snowhouse," says Vilhjalmur Stefansson, famous Polar explorer. Actually when an Eskimo speaks of his igloo he may not mean a house of snow. After ten winters in the far north, Stefansson defines an igloo simply as "a more or less permanent shelter for man or beast." It may be built of logs, bones, stones, sod, or snow, according to the custom of the tribe.

Can Soft Drinks Poison You?



When you visit the soda fountain you get food and stimulant because, as this drawing shows, much sugar and fruit acid go into soft drinks.

Billions of bottles of beverages are drunk in America each year—Analyzed by the Government Pure Food Board, harmful ingredients are kept out of them—This article tells why locally made drinks may prove injurious

By GEORGE LEE DOWD, JR.

TO QUENCH the Great American Thirst, eleven billion bottles and glasses of soft drinks are consumed every year—enough to fill a giant bottle as wide at the base as a city block and twice as high as the Empire State Building, the world's tallest structure! This means that, if you are a law-abiding citizen in good health between eight and eighty, you probably will drink an average of one glassful a day during the three hot summer months.

These sweet, fizzing liquids, pink, orange, green or amber, will cool your parched throat at the ball-game, at soda fountains, or at roadside hot-dog stands. But what will they do to your health? Are they as wholesome and harmless as they look and taste?

In most cases, you may rest assured that they are. The Government sees to that. They are tested and approved (or condemned) by Government laboratory experts. Because soft drinks contain a small percentage of food value, they come under the control of the U. S. Food and Drug Administration. To enforce the Food and Drug Act, the Department of Agriculture maintains a staff of 530 administrative officers, chemists, and other specialists in Washington and sixteen other important cities. It is part of their job to analyze your soft drinks, even if they consist of nothing but charged water.

Still, there remains a certain risk, but there are tell-tale signs by which you can distinguish a good drink from a possibly harmful one. Unfortunately, the Federal authorities, under the law, have control only over bottled beverages and syrups that are shipped from State to State, but lack the power to test those that are sold in the State where they are made. As State and other local laws on the subject either are sketchy or non-existent, the small local manufacturer often can let his conscience be his guide as to what he will put into his brew.

IN OTHER words, when you order a nationally distributed product, you will get a safe drink. Whether you stop for it

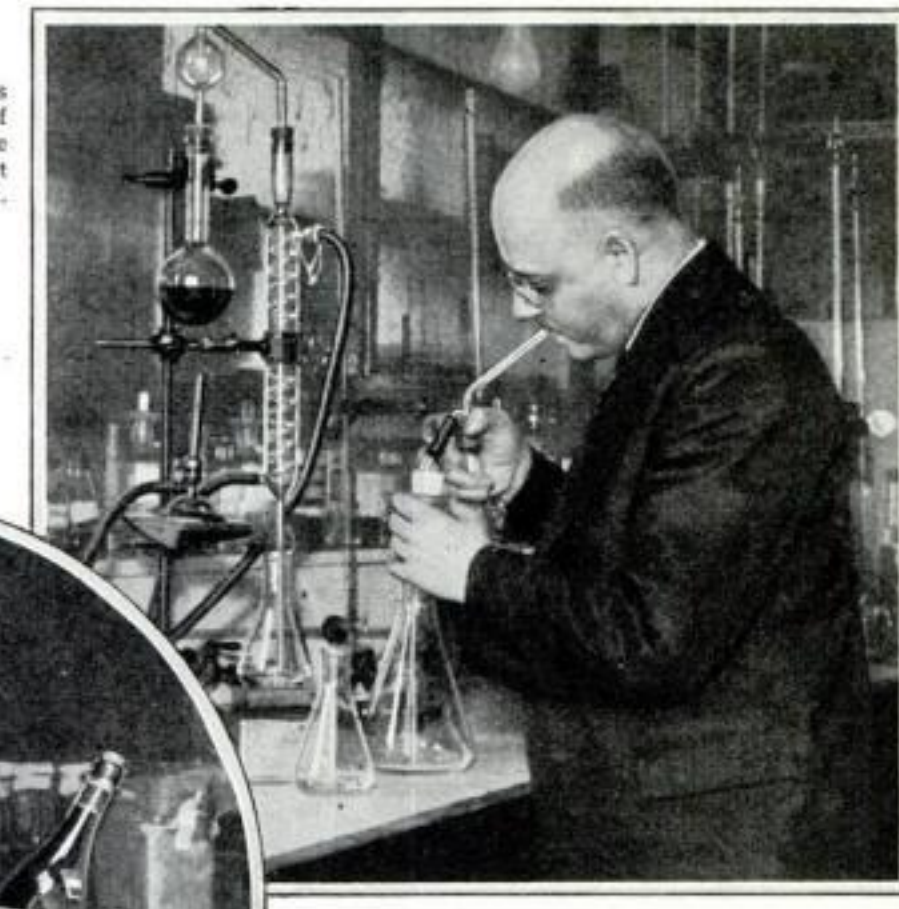
at the humble roadside booth or at a marble soda palace in the city, makes no difference, except, possibly, in the price. But when you buy a locally made drink, and especially pink "lemonade" at a carnival, fair, or small circus, there is no way of telling with what horrible concoction you may assault the inner man.

How can you tell the difference when the stuff is in a bottle? The cap and label will show you at a glance whether the drink is Government tested or not.

For example, almost all fruit drinks contain artificial coloring. Cap or label will tell you whether or not any has been used in making your beverage. If it has, this is no indication of poor quality. Nor need you be frightened because it has been "artificially flavored." Both artificial colorings and flavorings must conform to the standards of the Food and Drug Administration. Sometimes, they are even beneficial.

At right, the chemist is blowing off a sample of a well known beverage to distill it and find out exactly what is in it.

Samples of all soft drinks are sent to the Food and Drug Administration and below a record is being made of sample received.



A PECULIAR quirk in human nature is responsible for the use of these substances in most beverages. As a matter of fact, you would probably refuse a glass of your favorite fruit drink if they had been left out of it.

The reason is this: When the juice is crushed from strawberries, raspberries, grapes, and the like, it is cloudy because a fine residue from the fruit cells remains in it. Americans won't buy a cloudy drink, and so the manufacturer strains the juice through a filter or treats it with a clarifying chemical, such as kaolin.

Either treatment clears the juice but robs it of much of the taste and flavor that make you like it. To replace them, the manufacturer has to resort to some harmless coloring and artificial flavoring. Fifty thousand pounds of coloring matter and five million pounds of fruit acid are annually used in this way. This increases the price of your drink, but you have your own prejudice to blame. There is no harm in cloudy fruit juice.

Buying a soft drink from a roadside hot dog stand is just as safe as getting it at a city drugstore.

ANOTHER artificial process is brought into play in the making of root beer. You like it rich and foamy? The manufacturer sees to it that you get it that way. The foam on root and birch beers and on sarsaparilla is a product of saponin called "gum foam." Only one type of saponin is harmless or non-toxic. All other kinds cause diffusion of the hemoglobin, that is, the red coloring matter in the blood, and, consequently, anemia.

However, you may drink your favorite brand of root or birch beer or sarsaparilla with perfect peace of mind so long as it is the product of a national manufacturer, because the Food and Drug Administration considers drinks of this sort that contain toxic saponin as adulterations, and rules them out.

Jealously guarding both your health and your pocket book, the Government insists on "realism" in the pictures on the labels. That does not mean that Uncle Sam sets himself up as an art critic. The authorities have laid down a hard and fast rule that the manufacturer of a fruit drink cannot display a picture of a fruit on his label unless the drink actually contains the juice of that fruit. All of this was set forth in a long Court opinion with the amusing title: "The United States of America vs Ninety-five Barrels (more or less) Apple Cider Vinegar"!

One manufacturer had been using a picture of an orange on his label for many years and describing his drink as containing the juices of oranges and orange peels. He was ordered either to change his label or add genuine fruit juices to his product. Rather than destroy the value of his established trade-mark, he is now spending more than $100,000 a year for the real juices.

Sharing the popularity of fruit juices, root beers, and other "soda pops," are the cola drinks. Here is a question thousands have been asking for years: Do they really contain a narcotic? They do, but very little of it. In addition to sweetening, acids, and carbonated water, they contain the juices of the coca leaf and the cola nut. For the leaves the manufacturers have to send to South America, while the nuts come all the way from Africa. And all that to give you that little "kick" in your drink!

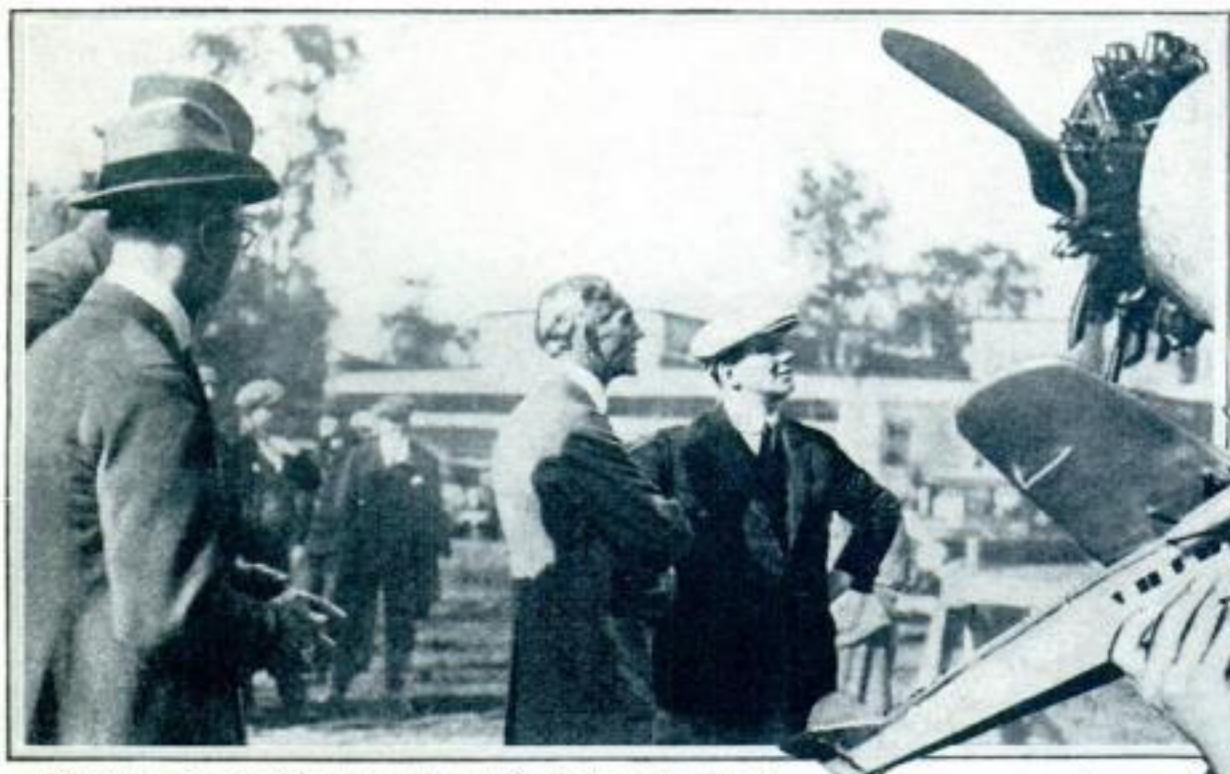
THE coca leaf contains morphine, but this is removed before its juice gets into the syrup. It is the cola nut that provides the slight stimulant—caffein, a narcotic. The question whether caffein is a habit-forming drug or not is still up in the air. In any case, the average bottle or glass of the drink containing it holds only about one-half grain, considerably less than the quantity in an ordinary cup of coffee, tea, or cocoa.

But the caffein in a cola drink does not always come from the juice of the cola nut. Sometimes it is derived from coffee, tea, or cocoa. One manufacturer of such a drink is said to be the largest importer of tea sweepings in the United States.

Are soft drinks nutritious? Do they actually stimulate? May they be taken without fear of harmful effects?

These three questions J. W. Sale, chemist in charge of the Water and Beverage Laboratory of the Food and Drug Administration in Washington, answers with an emphatic "yes," provided, of course, that the beverages *(Continued on page 128)*

Tony Fokker Captures America



Tony Fokker, in 1925, shows Henry Ford the principle of the tri-motored plane that had won in reliability race.

Fokker with a model of his *Southern Cross*, the famous plane piloted around the world.

When Peace Came the Great Airplane Builder Faced Wild Times That Took His Wealth and Threatened His Life

By ROBERT E. MARTIN

A MURKY morning in November, 1918, in a dim old arsenal in Schwerin, German revolutionists were holding secret court. The prisoner was a slender, twenty-eight-year-old Hollander with a name familiar to the far reaches of the civilized world. He was Anthony Fokker, the Dutch designer whose fighting planes had carried Teuton aces to a thousand sky victories in the war just ended.

For five years, Fokker had been working day and night. The war had made him a Man of Destiny.

From his birthplace on the far-off island of Java, he had come to Holland at the age of six, had become interested in aviation when the Wrights first flew in Europe, had built a flying machine before he ever saw an airplane in the air. Then, after vainly trying to sell his machines to England, to Russia, to Italy, to Holland, in the days before 1914, Fokker planes had become the mainstay of the air offensive of the Central Powers in the World War.

Money had poured in. He had seen himself realizing his great ambition—accumulating enough capital to become a big builder of commercial planes. Then came the Armistice, and revolution sweeping the defeated nation; chaos, and Fokker's capital disappearing like April snow.

The revolutionists looted the banks, seized the factories, killed those who resisted. When the money was gone, they called on Fokker, marched him to their arsenal stronghold, and told him to send to Berlin for large sums immediately or be backed against a wall and shot. When he returned to his lodgings, two armed guards walked at his side.

But Fokker was more than a Flying Dutchman. He was a Fighting Dutchman. He was thinking fast, determined to save his capital. When night came, he put on the clothes of his landlady's son, slipped past the guards in the dusk, raced to a motorcycle hidden on a side street, and roared away toward a village, thirty miles off, on the main line of the railway.

Expecting pursuit, he rode like the wind, without lights, fearing each moment he would strike a hole or an unseen object in the dark. At the village, he hid his machine in a deserted garden. A freight was just puffing out of the station. He scrambled aboard, and, with thousand-mark bills stuffed in his boots, "rode the rods" to Berlin.

LATER, things quieted down. Loyal workmen wrote for him to return to Schwerin. Seeking to keep his men employed, he turned his plant into a canoe factory—and lost money. Then he tried manufacturing commercial scales—and lost more money. A final blow, that seemed a knockout, determined him to leave Germany. The terms of the Armistice ordered practically all airplanes, and "especially, all machines of the D-7 type," destroyed. Fokker's superiority was thus recognized by special mention in the Allies' Armistice terms!

But the cost of the advertisement was too high. It ended his future in Germany. More than that, much of his precious capital was tied up in D-7 planes and motors, marked for slaughter.

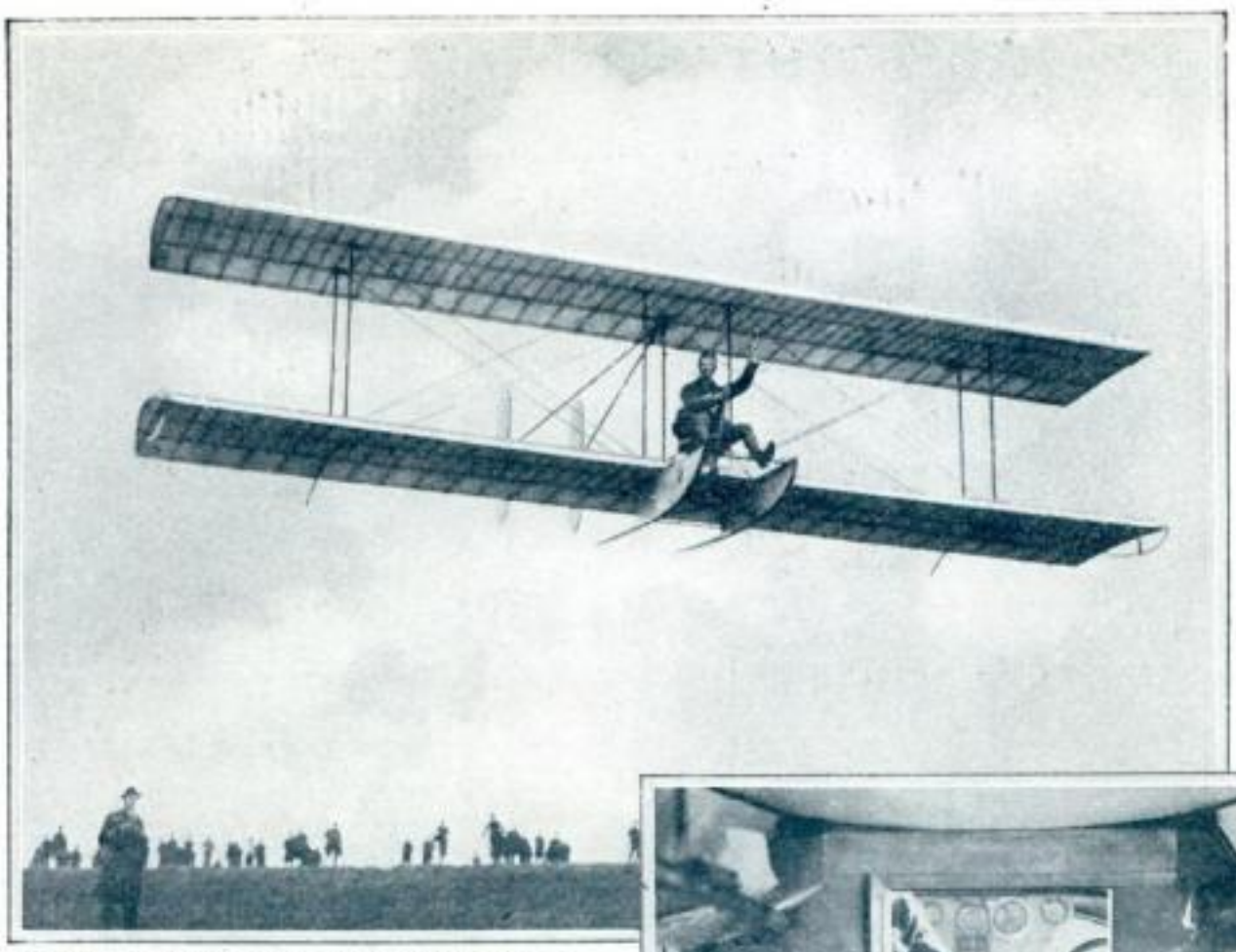
Determined to outwit the Allied Commission, he hired out-of-the-way barns, old cellars, vacant rooms, and in them hid 220 planes and 400 motors. When the Commission reached Schwerin, it found only a few government planes to destroy.

THEN began one of the most amazing smuggling plots of history. An airplane can't be hidden any more than an elephant. Yet with spies on all sides, with the Allied commissioners watching like hawks, and with the borders guarded at every point, Fokker transported nearly a quarter of a thousand planes and several hundred motors across Germany and into neutral Holland, without detection!

In long trains of sixty cars, the prize rolled to its destination. German sidings could hold only forty cars, so once the contraband material started on its way, it had to keep going. As each train neared the Holland line, a report of smuggling at another point along the border drew the guards away.

All railroad officials were carefully bribed, those in Germany with money, those in Holland with models of Fokker planes, bicycles, and sewing machines. So well was the path of the goods "oiled" that when unmarked covers ran out at the factory, the last of the planes were hauled to Holland with "FOKKER" boldly lettered on the tarpaulins covering them!

How much money Fokker made during



Fokker in his own soaring plane took part in contests in the Rhoen Mountains in 1922.

the World War, he will never know. He believes his profits mounted to nearly 30,000,000 marks. But at least three fourths of this was lost before he reached Holland.

LEGEND tells how the Flying Dutchman hopped off at midnight in a mystery plane freighted with millions and flew his money out of Germany. In fact, he did build a special two-seater for such a flight, but he was too closely guarded to make the hop. Most of the capital that reached Holland came on a little yacht that sailed away from Travemunde into the Baltic Sea one day, ostensibly on a pleasure trip.

Another half million dollars arrived in a battered old suitcase. It was checked to Holland as belonging to the cook of a traveling diplomat. It got to its destination hanging by one strap, with both locks sprung and the two halves gaping a half an inch apart. But miraculously enough, the fortune in bills of high denomination was intact.

There is a romantic and little-known tale connected with the building of Fokker's "money plane." One day, during the war, he was yachting on a lake near Berlin, when the daughter of a German general was thrown into the water from another yacht. He leaped overboard to rescue her. Later, they became engaged.

Twenty-three years separate Fokker, center, from his first crude efforts to fly in his father's attic and this mighty Pullman of the air.

AS he could not get married in Germany without giving recognition to the illegal decree that had made him a German citizen against his will, he designed the plane to carry two, so he could fly to Holland with his fortune and his bride-to-be.

Later, when they did cross the border, by train, Dutch officials refused to marry them. Newspapers had reported that Fokker was a German citizen and he could not convince them otherwise. Only by appealing to Prince Hendrik, the Queen's husband, was he finally able to get married!

AFTER he sold the planes and motors he had brought from Germany, Fokker began manufacturing commercial machines in Holland. His five-passenger F-2 was the first cabin commercial monoplane ever built. It was the great-granddaddy of modern air-liners.

In 1922, a sailplane competition was held among the Rhoen Mountains of central Germany. Here, the Flying Dutchman, wearing a white handkerchief, knotted at each corner, as a cap, was a familiar figure. He piloted a soaring biplane that had been built at his factory according to specifications he had sent by wireless from mid-ocean.

Once he jockeyed about in the rising air currents for thirteen minutes, carrying a passenger who filmed movies of the crowd below. This was the first passenger-carrying soaring flight on record and the first time movies were taken from a sailplane in flight.

The next year, 1923, Fokker planes made a dramatic entrance into America. James A. Macready and Oakley G. Kelly, two Army lieutenants, piloted one of the Holland-built giants, lifting five tons, on a non-stop flight from coast to coast. The single 400-horsepower Liberty engine pulled the big machine across the 2,520 miles in a little more than twenty-six hours. Coffee put in their vacuum bottle in New York was still hot when they landed within sound of the Pacific breakers at San Diego, Calif.

This historic monoplane now hangs beside a D-7, captured at the front, in the aerial Hall of Fame at the Smithsonian Institution in Washington, D. C.

By the time Fokker had sold $750,000 worth of planes to the United States Army and Navy, he decided to establish an American plant and formed the Atlantic Aircraft Corporation at Hasbrouck Heights, N. J. In this plant were born many of the mounts that carried the aces of peace — Byrd, Balchen, Maitland, Hegenberger, Kingsford-Smith—to new conquests of the sky.

The Dutch designer was working at top speed. Conferences, plans, designs, kept him busy from morning until night. With factories in two countries, he rushed back and forth across the Atlantic with the regularity of a commuter. On one of these trips he figured out a way to sling extra motors *(Continued on page 131)*

In this plane, *America*, built for Byrd's transatlantic flight, Fokker, with Byrd and his crew, had a miraculous escape from death when it crashed in test at Teterboro field.

Blind Can Read Any Book with Aid of Electric Eye

FOR the first time in history the blind can now read any printed book. An electric eye in the "printing visagraph" virtually confers the gift of sight upon the sightless. It instantly transcribes the ordinary print of a book into raised, magnified letters that can be read with the finger.

The machine, recently exhibited in New York City by the inventor, Robert E. Naumburg, of Cambridge, Mass., resembles an office desk. When a book is inserted, an electric eye in a rolling carriage of brass roams back and forth across the printed page. What the "eye" sees is reproduced in embossed letters upon a roll of aluminum foil at the machine's right. A blind young woman who had practised only thirty days upon the machine amazed spectators by reading a book as fast as the raised letters jumped up one by one beneath her fingers.

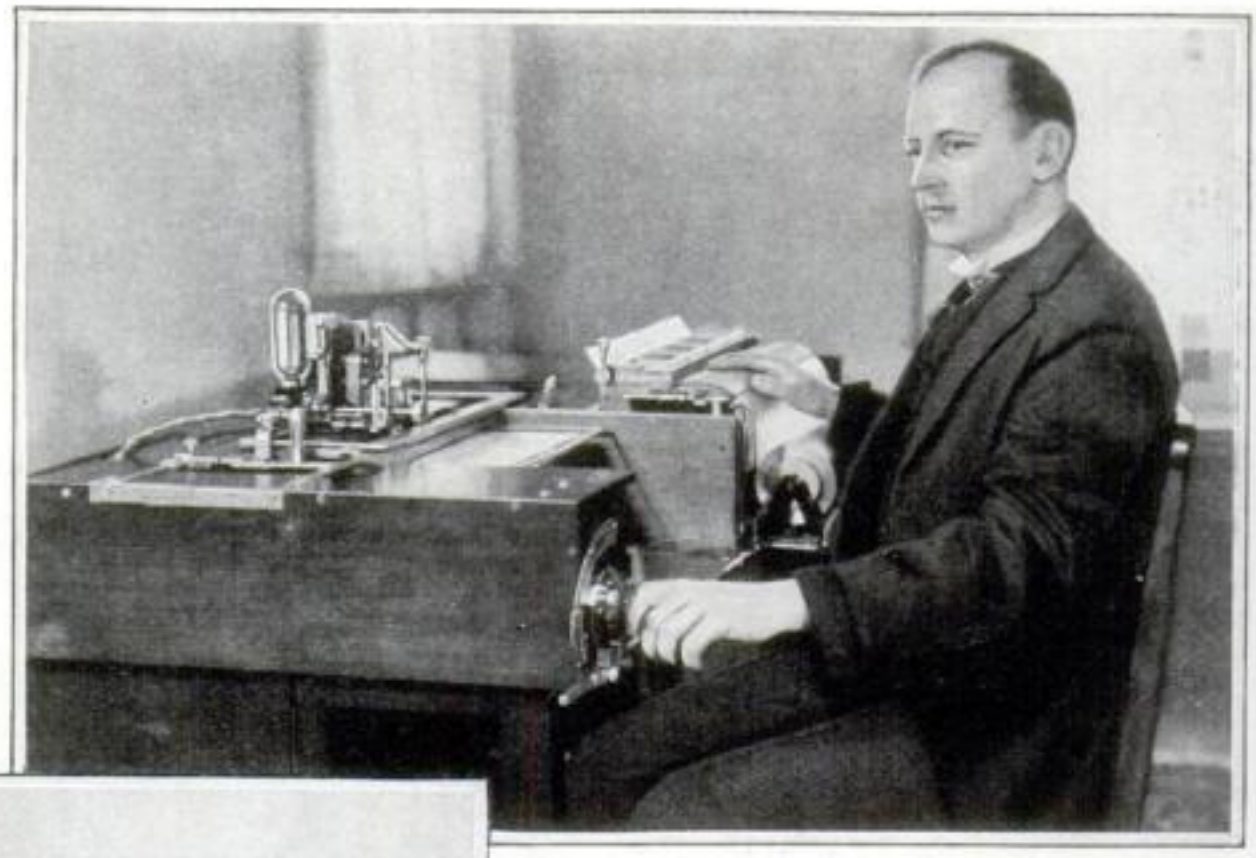
After being read with the finger tips, the aluminum sheet may be preserved for future reference or it may be run through a pair of rollers like a clothes wringer, flattening out the letters, so it can be used again.

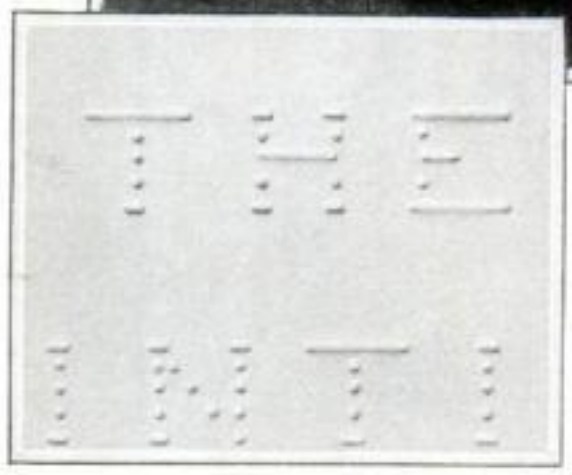
How the machine is able to reproduce ink-printed letters in raised type is shown in the diagram on this page. The principle is simple. Two parts compose the machine—a transmitter and a printer. The transmitter reads the book. Its impulses are forwarded to the printer, which copies the letters in dots and lines upon the aluminum strip as the printing carriage moves across it from left to right.

This is done by drawing six tiny beams of light, arranged in a vertical row, along the printed line at the transmitting end. Each beam is a sort of exploring feeler for one of six printing bars in the printer; the lowest one, for example, finds the tails of letters like "p's" and "g's." When one of the exploring beams strikes the black part of a letter, it energizes the corresponding printing bar. The bar then imprints a dot or line on the aluminum, depending on how long it is held in action.

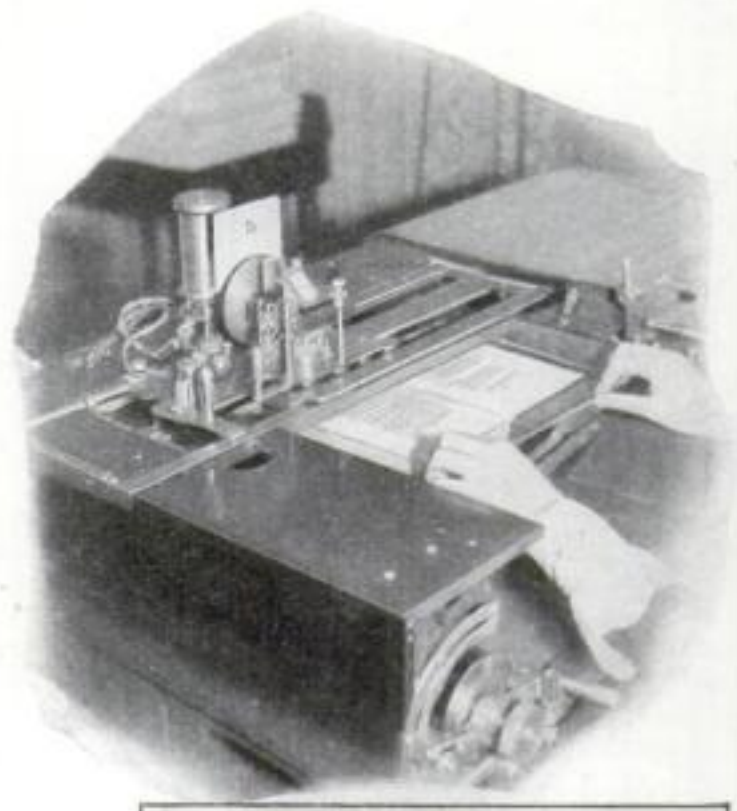
A blind person can make the adjustments needed in inserting a book, and operate a lever that shifts the eye from line to line.

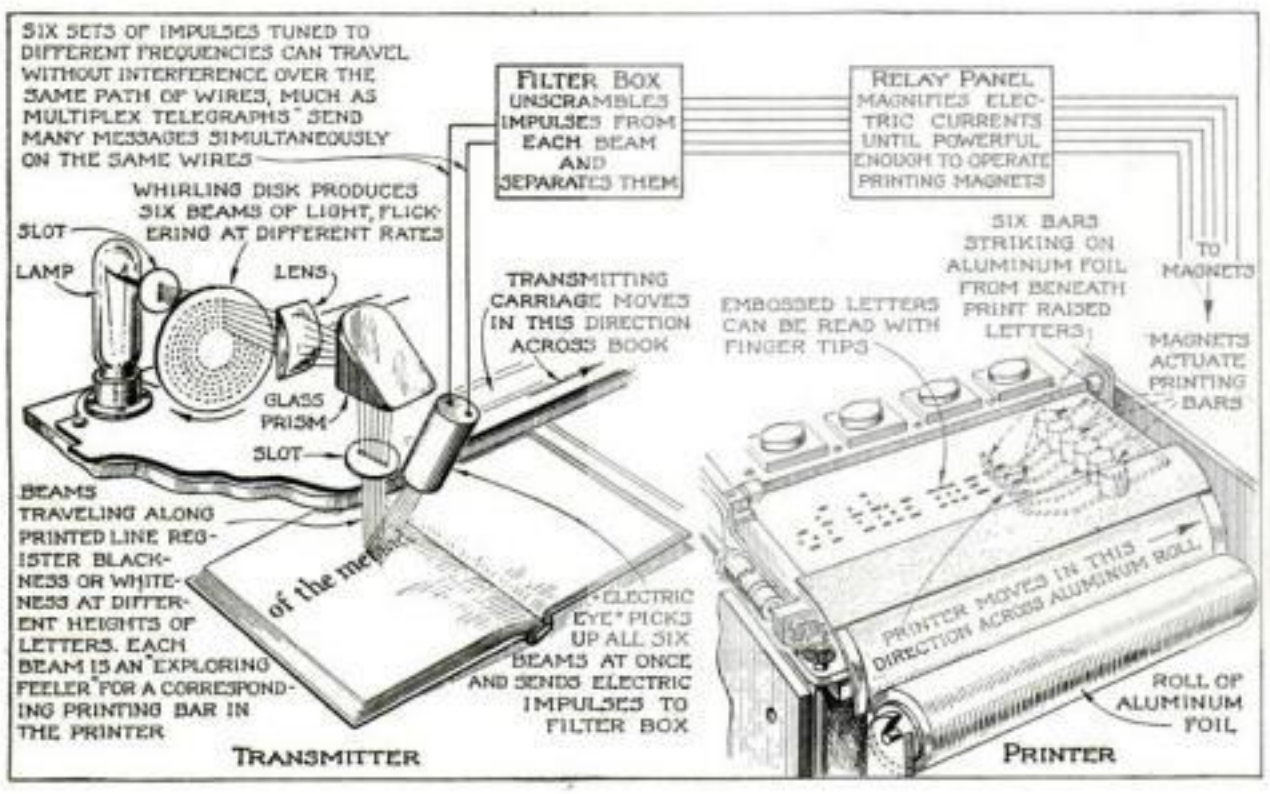
Though it took the inventor four years to perfect the printing visagraph to the point where it could read book type, he told POPULAR SCIENCE MONTHLY that he was constantly improving it. Soon, he says, it will be able to read magazines and typewritten letters. His most difficult problem was in finding a suitable recording medium. He found it in an aluminum sheet bearing a corrugated pattern, put there for ornament.

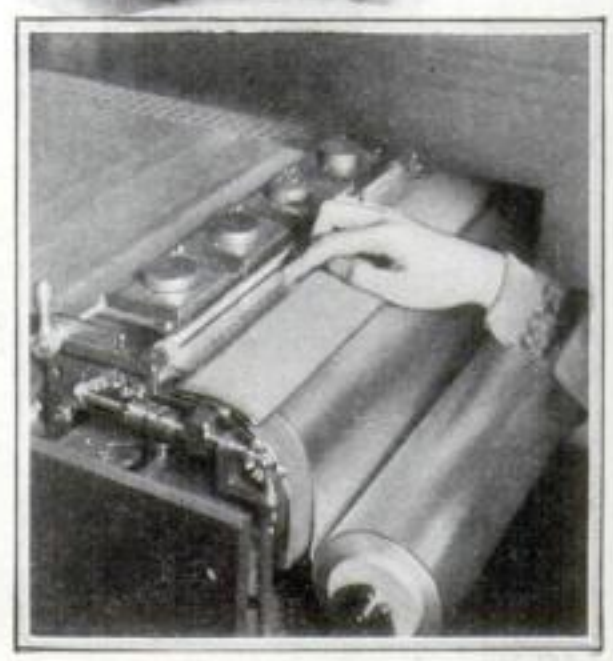




Above, Robert E. Naumburg, inventor of the printing visagraph by means of which the blind can read any printed book. At left, sample of raised letter it makes.







At top, inserting a book in the visagraph. **Note the carriage holds the electric eye. Above, here is where the raised letters come up at the rate of twenty words a minute to be read with fingers. At left, diagram showing how the electric eye reads the printed type.**

Potomac Bridge Rises Up to Open 90-Foot Channel

General view of the Potomac River and drawbridge that is opened when the two halves swing upward to open a 90-foot boat channel.

WHIRRING machinery raises two sections of the center span of the new Arlington Memorial Bridge over the Potomac River at Washington, D. C., permitting river craft a clear passage. Both sections open upward on hinges like enormous trapdoors. Machinery and counterweights for operating the two hinged sections are concealed below the bridge structure. In other bridges of this type these were placed in huge towers at either end of the draw.

Since the Arlington Memorial Bridge affords a clear passage of ninety feet when open, it is said to be the largest bridge of the lifting-draw type ever built without counterweight towers.

One man actually operates the two leaves of this unusual bascule draw. Every position of each leaf is shown him by colored lights on the table in front of his eyes as well as by a huge moving finger on the wall. He is in constant communication by telephone with every other part of the bridge, which is 2,163 feet long.

Above, raised span lets river craft through the Arlington Memorial Bridge. At the left, in control room where one man runs lifting machinery. Lights show span's position.

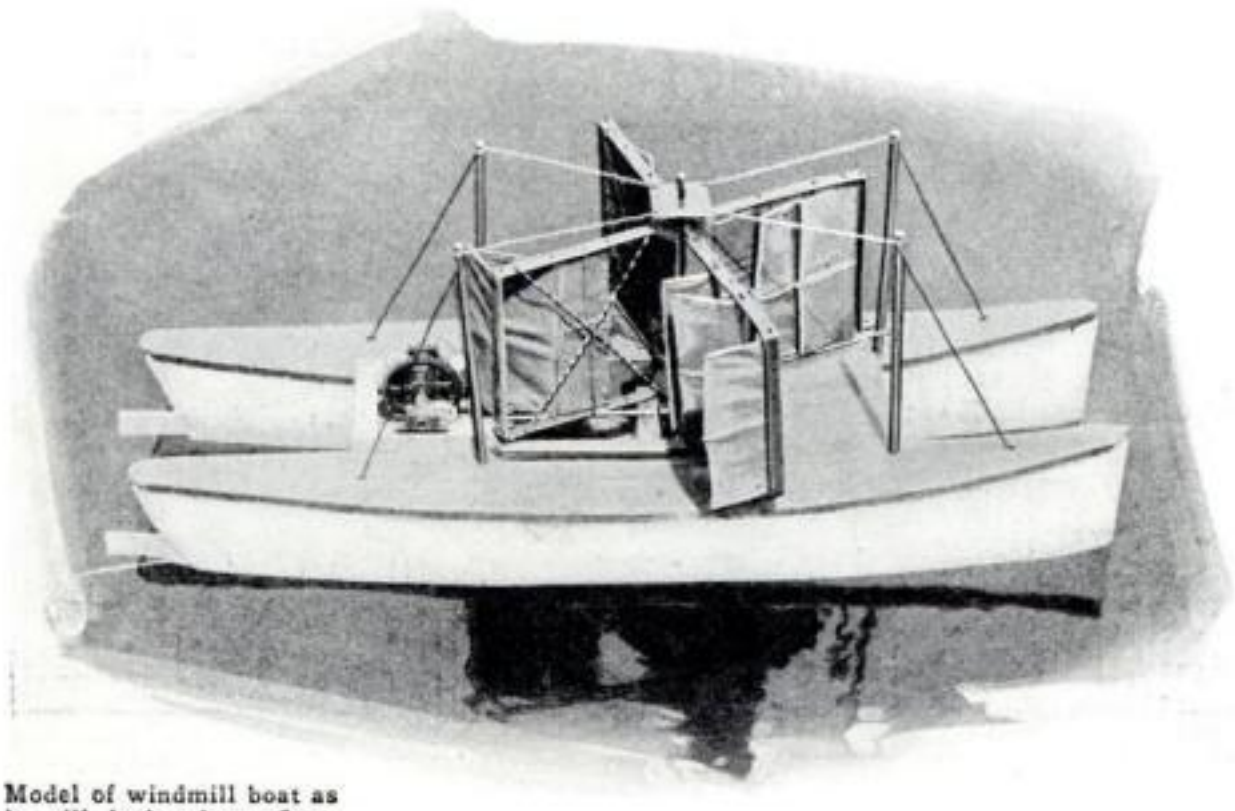
MOSQUITOES USE CHIMNEY WHEN SCREENS ARE UP

IN SOME southern parts of the United States, malaria-bearing mosquitoes are reported to enter houses through chimneys. They choose this means of entry after doors and windows are screened. However, chimneys also can be barred against them, says the United States Public Health Service, by hanging a small quantity of naphthalene, of which moth balls are made, at the chimney top.

WINDMILL BOAT AIMS AT HIGH SPEED

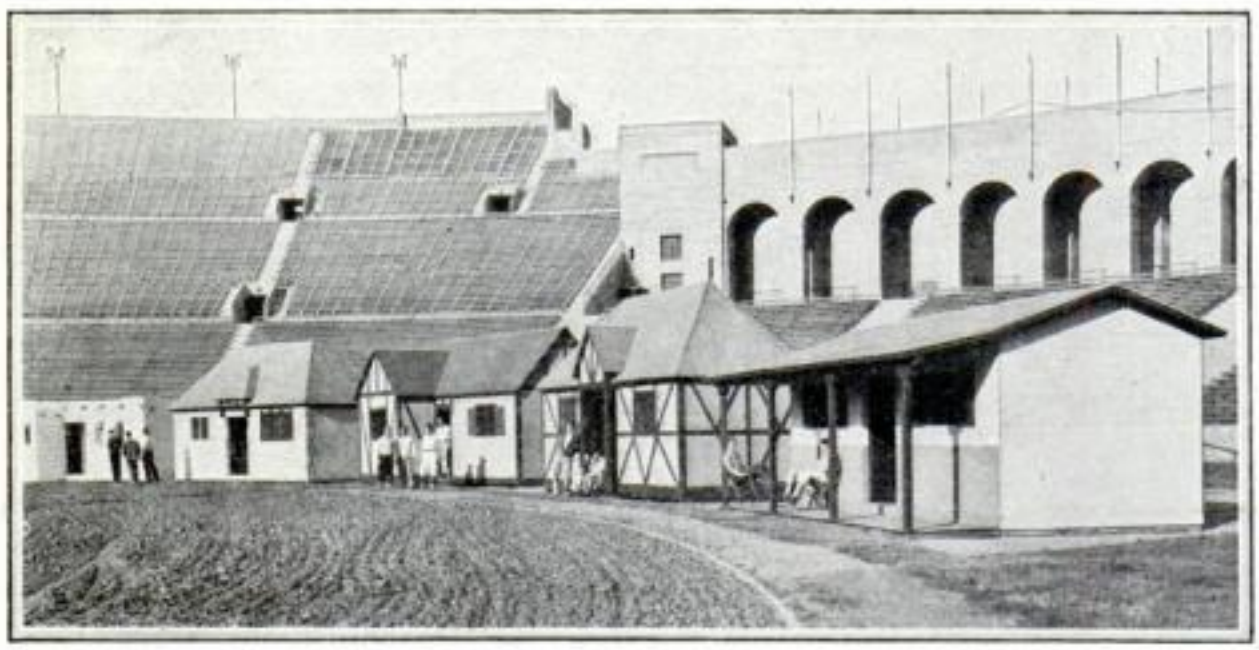
KNOWN as the "windmill boat," the strange craft at left exists only in the shape of a small model. A full sized boat built on the same principle should prove capable of skimming the ocean at high speed, its inventor declares.

Louis Sher, of Philadelphia, Pa., who patented the craft, arranged vanes on a shaft so that they rotate it by wind pressure through vanes hinged at one edge only. As the shaft rotates the vanes swing edgewise toward the wind and then overlap to form an unbroken surface against which the wind can exert pressure.



Model of windmill boat as it will look when afloat.

MODEL VILLAGE FOR OLYMPIC ATHLETES



A ROW of miniature "cardboard" houses stands at the side of a California stadium, where the tiny dwellings are being tested for their weatherproof qualities. If they prove impervious to rain and wind, they will serve as models for the village near Los Angeles that will house 3,000 athletes during the Olympic Games of 1932.

When the contestants arrive from all parts of the world, each will find a house patterned after the architecture of his own country. Dwellings in French, Spanish, German, and American styles have been modeled. Each provides lodging for four men.

The group of several hundred houses, a 1,200-foot-long dining hall, and a large administration building will be laid out in streets like a city and known as "Olympic Village." It will be the first time since the games of ancient Greece that the athletes will be centrally housed and fed.

Since the structures are as temporary as those of a "boom town" of gold rush days, their roofs and sides will be covered with wood-fiber insulating board.

NEW OUTBOARD MOTOR IS COOLED BY AIR

A NEW type of outboard motor, developed by a mid-western manufacturer, has a flywheel which acts as a cooling fan. Blades cast into its rim draw air down over the engine cylinders. Vanes cast into the cylinder walls according to standard air cooling practice are cooled by the rushing stream of air from the whirling flywheel.

Using an air cooling system with these engines has made them lighter than those cooled by water, which, up to this time, has been the usual practice. This is an advantage, for these little motors, so popular with motorboat fans, often have to be carried about by hand, as frequently the engine is removed when the boat is not in use or when it is desired to use different motors in a boat.

Blades are cast into the rim of this outboard motor flywheel to force air down to cool engine.

ELECTRIC WORM DIGGER AIDS FISHERMEN

AN ACCIDENT led to the invention of an electric fishworm digger.

Last August, a party of radio men on a fishing trip at Bass Lake, Wis., rigged up an extension lamp on a cord, with a metal stake to stick it in the ground to aid in searching for worms at night. Electricity leaked into the ground through a defective lamp socket. Up came worms by the dozen. Currents passing through the earth shocked them and they sought escape at the surface.

The result was the electric "worm digger" shown in the photograph. When its metal rod is attached by a cord to a light socket or automobile battery, all the worms within a radius of six to ten feet come up a minute or two after the current is turned on.

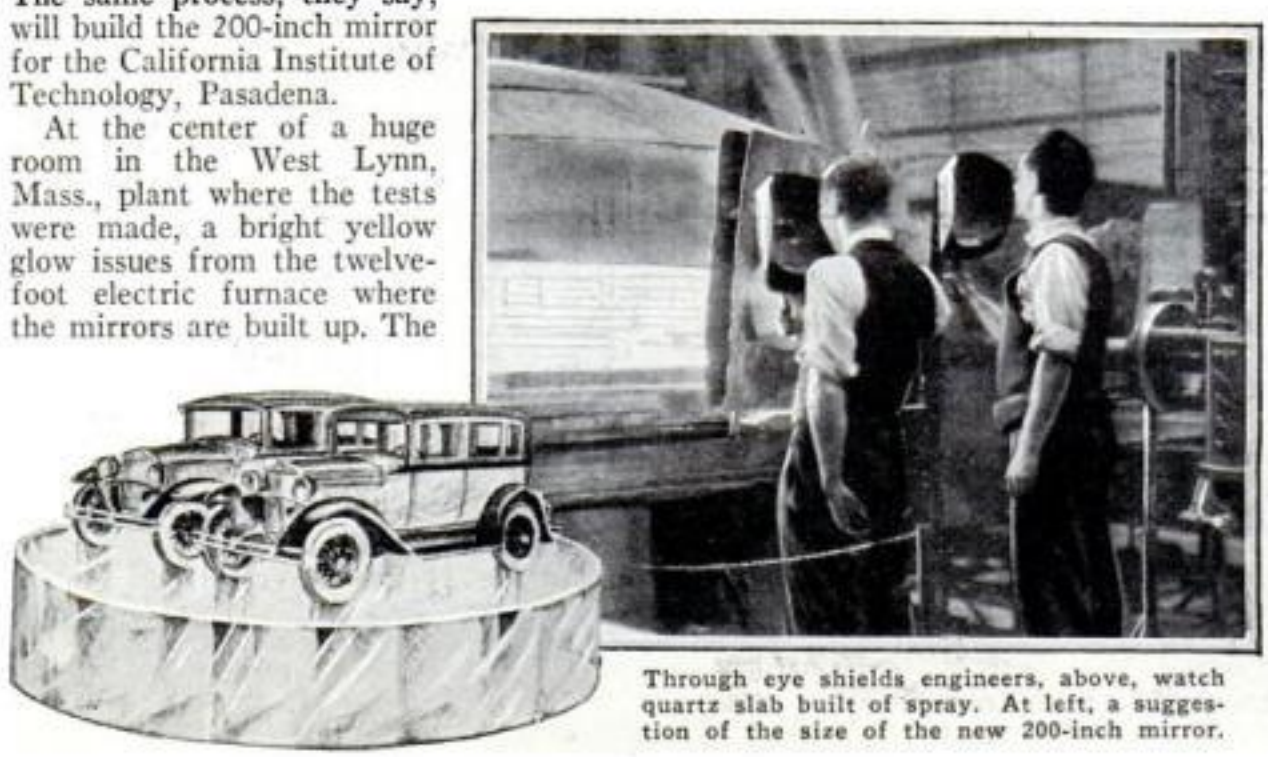
One Braceville, Ill., man uses the device to feed his chickens, changing its position several times a day. A Joliet, Ill., golf course uses a dozen to keep away large "nightcrawlers" that spoil the greens.

LEARN HOW TO BUILD GIGANTIC MIRROR

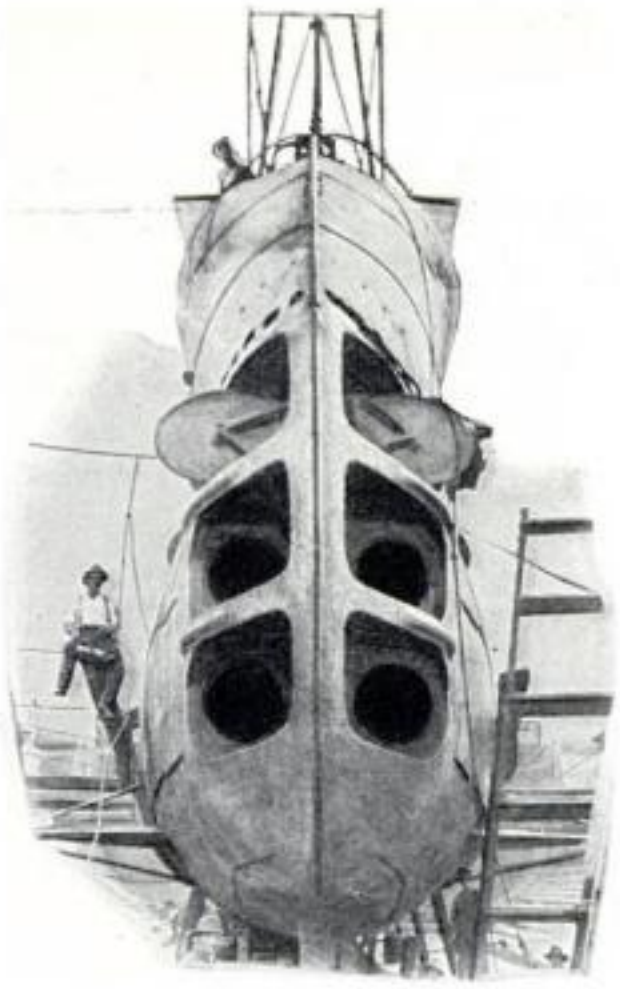
WHEN the biggest telescope mirror in the world was ordered, nobody knew how to build it! That was the situation until General Electric engineers recently announced they had succeeded in making a five-foot two-ton disk of fused quartz, the largest mass of that substance in existence. The same process, they say, will build the 200-inch mirror for the California Institute of Technology, Pasadena.

At the center of a huge room in the West Lynn, Mass., plant where the tests were made, a bright yellow glow issues from the twelve-foot electric furnace where the mirrors are built up. The entire thickness is formed with a spray of molten quartz. A steady hum permeates the room, the drone of eight hundred kilowatts of electricity used in the heating apparatus.

The mirror will be large enough to hold two automobiles side by side.



Through eye shields engineers, above, watch quartz slab built of spray. At left, a suggestion of the size of the new 200-inch mirror.



SUB, OUT OF WATER, SHOWS ITS "TEETH"

A BIG "fish" out of water is the British submarine *Oxley*, attached to the Australian squadron, as it was photographed the other day in dry dock. This unusual picture of an undersea fighter gives a good idea of its "teeth," or the tubes from which it fires torpedoes.

Unlike the torpedo tubes of destroyers, which are mounted on the open deck and can be pointed like guns, the tubes of submarines are built rigidly into the hulls. Thus, when one of the deadly weapons is to be fired, it is necessary to "aim" the vessel at the target.

The surprising height of the submarine in comparison with its narrow beam is also clearly shown in this picture.

HIDDEN TEAR GAS GUARDS NEW SAFE

SHOULD an unwary burglar attempt to open a safe of new design, he would suddenly burst into tears—and dash for the fresh air. A flood of tear gas accounts for the speed of his departure from the vicinity of the safe.

Any effort to burn, drill, or knock off the combination on the door of this safe automatically releases the blinding vapor from a hidden vessel within it, thus routing the intruder in short order.

So effectively did this device frustrate the efforts of two bandits to rob a Philadelphia concern recently that police easily captured them as they wandered, dazed and half-blinded, about the building in an effort to escape.

Burglars are baffled by this new type bank safe, unless they have brought gas masks, as it contains tear gas freed by door.

BALLOON TIRE ON WHEELBARROW

EVEN wheelbarrows now have pneumatic tires, whose air cushions make work easier for gardeners in the city parks of Birmingham, England. When barrows are loaded, the broad rubber treads of balloon tires on their wheels do not sink into soft ground, do not injure lawns, and are not noisy on paved walks. Tires are inflated with small hand pumps similar to those used for bicycle tires.

"MIKE" HELPS KEEPER CARE FOR FOXES

WHEN valuable silver fox cubs squeal for food at a Thuringia, Germany, fox farm, the keeper, though he may not be near enough to hear them, knows immediately that they are hungry. Each cage contains a microphone, carefully shielded from inquisitive paws by a guard of wire netting.

Electric wires lead from the microphone to the keeper's house, where they are connected through a selecting switch to a standard loudspeaker. By turning the switch, the keeper can listen in upon what is happening in any particular cage. He is thus able to interrupt fights that might otherwise prove costly or hasten to the relief of a cub whose whines suggest illness, or perhaps only hunger or thirst

Above, a cage for silver foxes at Thuringia, Germany, in which has been placed a microphone in shield attached to ceiling. Left, the keeper listens in over his loudspeaker.

WALKER IN DELAWARE MUST SHOW SIGNAL

NIGHT pedestrians on country roads in the State of Delaware are now required to show signals. They must either carry a white handkerchief conspicuously displayed or a lighted lantern. Without a display of the proper signals during the hours of darkness, a Delaware walker is in the same class as a ship running without lights—he has no claim against the person accidentally injuring him.

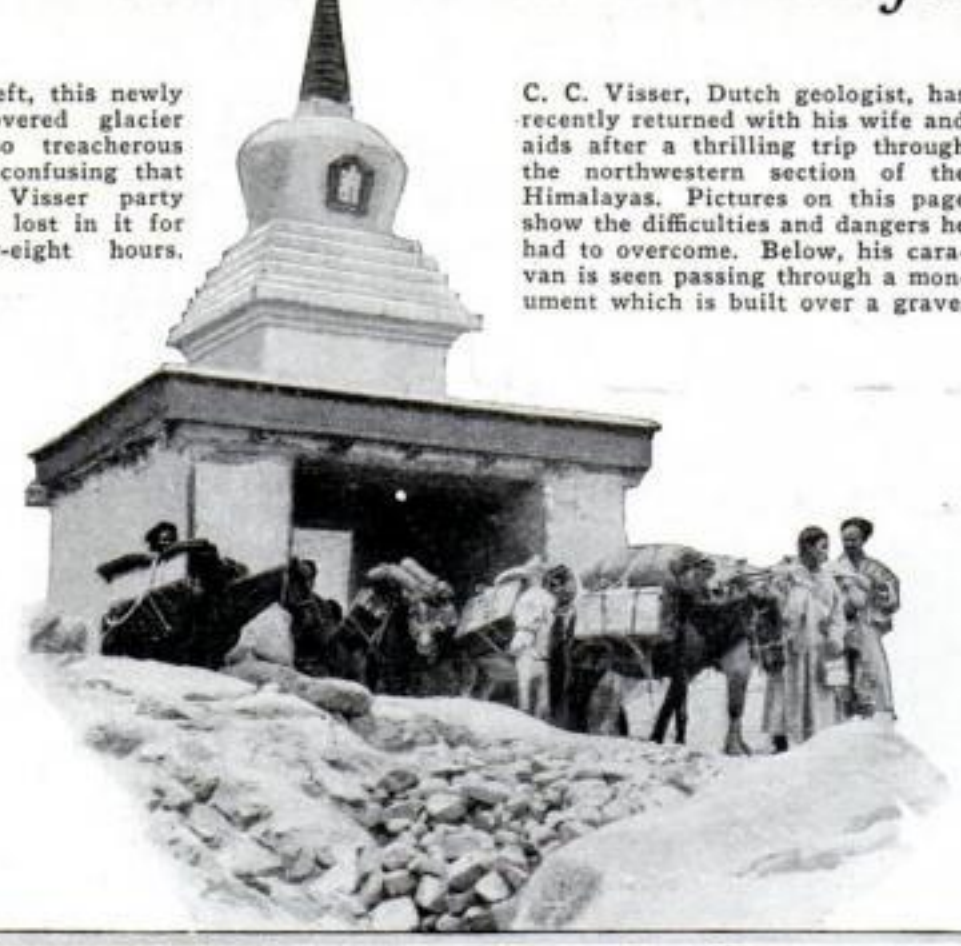
NEW YORK NOW PLANS MECHANICAL HEAVEN

NEW YORKERS, according to Dr. Clyde Fisher, curator of astronomy at the American Museum of Natural History, New York City, soon may see a working model of the heavens. Plans are proposed for erecting a planetarium, similar to the one in Chicago described in an earlier number of this magazine (P. S. M., Jan. '29, p. 20), in the New York museum. A hemispherical dome will be the stage on which about 5,500 stars will perform for the benefit of spectators.

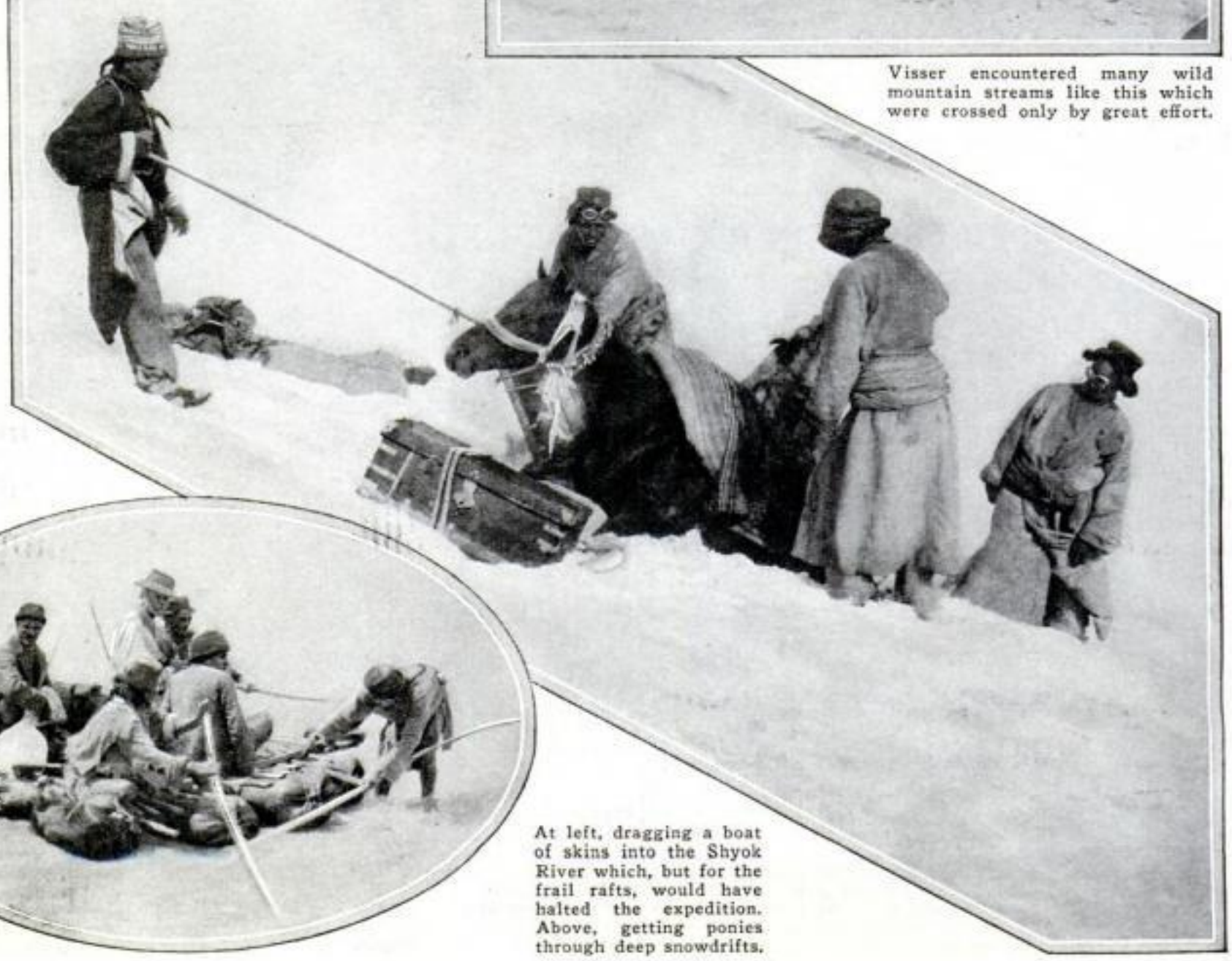
Explorers Defy Death to Climb Wild Himalayas

At left, this newly discovered glacier is so treacherous and confusing that the Visser party were lost in it for forty-eight hours.

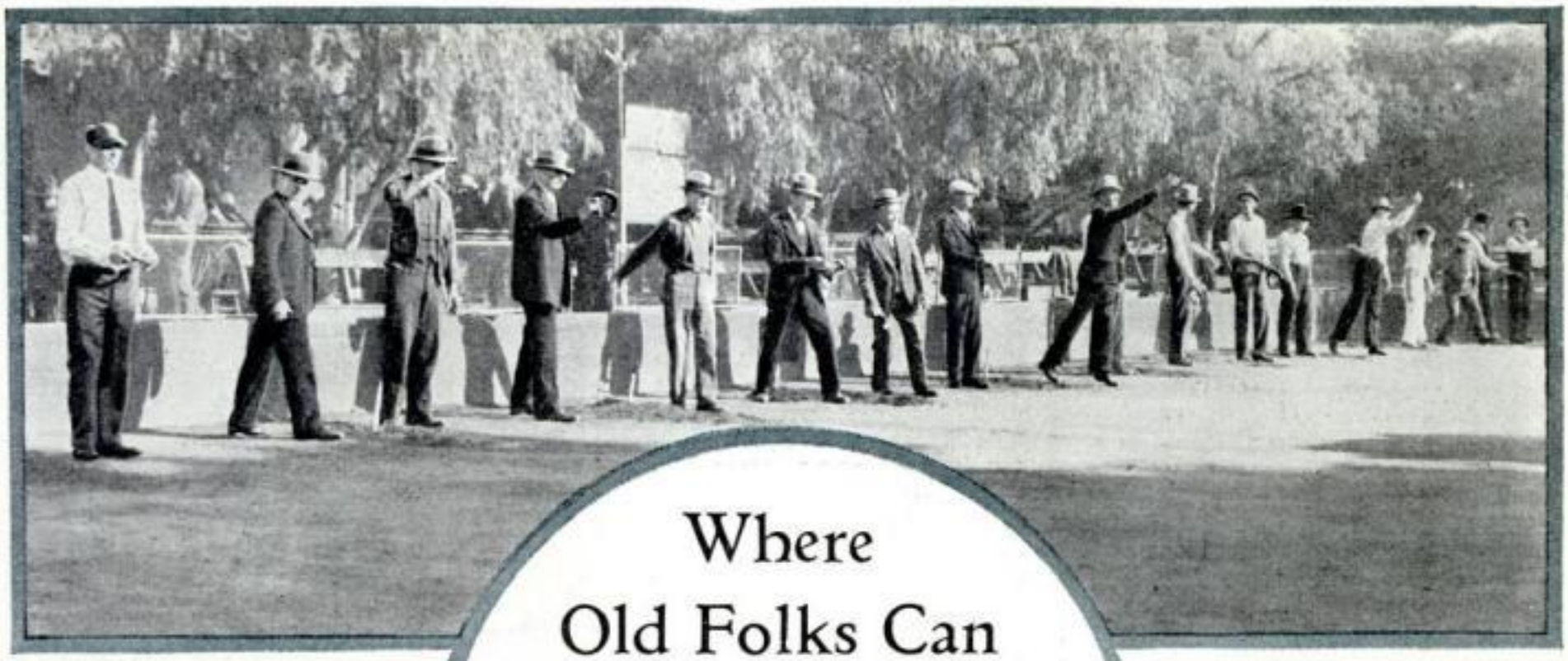
C. C. Visser, Dutch geologist, has recently returned with his wife and aids after a thrilling trip through the northwestern section of the Himalayas. Pictures on this page show the difficulties and dangers he had to overcome. Below, his caravan is seen passing through a monument which is built over a grave.



Visser encountered many wild mountain streams like this which were crossed only by great effort.



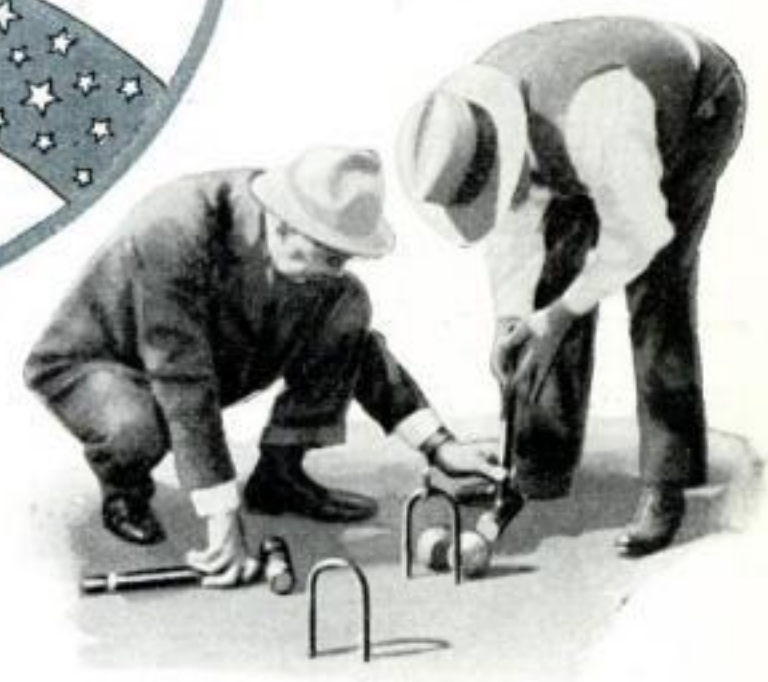
At left, dragging a boat of skins into the Shyok River which, but for the frail rafts, would have halted the expedition. Above, getting ponies through deep snowdrifts.



Where Old Folks Can Play Around

CHILDREN ARE BARRED. In California, playgrounds reserved exclusively for adults have been established in eleven cities. Many outdoor and indoor games are played and the charge is nominal. Below, Pasadena players "measuring up" in a championship game of lawn bowls.

A CHAMPION AT NINETY-TWO. The best horseshoe pitcher among the old folks at the San Diego playground is a young fellow of ninety-two. This photo, above, shows an eighteen-man horseshoe pitching tournament in full swing.



LEARNING FROM A MASTER. Above, left, the adult of eighty is teaching the youngster of merely seventy exactly how the shots in roque should be played. This is only one of the half-dozen roque courts maintained by the city of San Diego. Similar courts are at all of the California adult playgrounds.

WOMEN TAKE AN ACTIVE PART. Women, growing old in the ways of the world, are prominent in all of the outdoor games. Here they are seen, with the men, playing at shuffleboard, which is one of their favorite games, rivaled only by roque. At the right, photo proves that the card game section has its devotees. At these tables, placed in the shade of the big trees, the bridge players find opportunity to enjoy themselves during the afternoons.

BALL SHAPED OIL CAN SPRAYS LUBRICANT

A NEW type of oil can, shaped like a ball, creates its own pressure for projecting a fine spray of lubricant. The globular metal container has a nozzle, opened and closed by means of a hand screw. The oil or grease in the gun is dissolved in liquefied gas.

When the container is shaken, the gas creates a pressure and forces a spray of lubricant through the needle valve if it is opened with the screw. The can, it is said, is especially effective for oiling automobile springs and for coating metal surfaces to protect them from rust.

NOW YOU CAN POSE YOUR OWN PHOTO

A STUDIO in which you can pose your own portrait was demonstrated in New York City recently by its inventor, Luther G. Simjian, photographic director of the Yale medical School. Visitors enter a small room alone and try the effect of different poses before pressing a button that works the hidden camera shutter. Mirrors enable them to see what each pose will look like in a picture before they press the button. There are no attendants to make sitters self-conscious.

For full-face pictures they face a mirror at the corner of the studio compartment. Pressing the button causes this mirror to move vertically, uncovering the camera lens and snapping the picture. If profiles are desired the sitter faces a mirror arrangement at either side of the room and presses a button under one of two openings. A concave lens in front of the mirror reduces the image the sitter sees from lifesize to portrait size.

In this studio you can pose yourself for your own photo. Note mirror that shows sitter how pose looks.

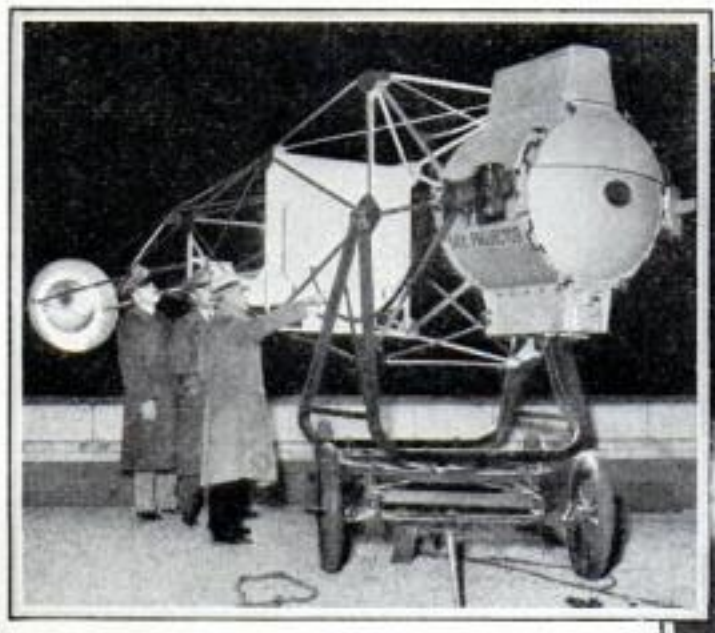
NEW SUBURBAN TAXI HAS THREE COMPARTMENTS

NEWEST of motor buses for American suburban service is the "taxi bus," a diminutive vehicle built on the compartment system used in European railway coaches. Instead of meeting trains with a small fleet of ordinary cabs, the suburban taxi operator meets them with a taxi bus, one of which replaces at least three small cabs. Each bus seats eighteen passengers, six in each of three compartments. Since a compartment is three seats wide, a taxi bus is no wider than an ordinary auto.

At each seat is a metal stanchion or column, in which there is a coin slot. In this a passenger deposits his fare after taking his seat. An electropneumatic device then carries it to the "taxi driver." Change or transfers are issued to passengers desiring them by a separate tube. Each compartment has its own entrance and exit doors worked by compressed air.

New taxi buses for suburban service are built in three compartments, each of which has its own entrance and will accommodate six passengers whose fare is taken by machine.

SEARCHLIGHT PRINTS AD ON BUILDING

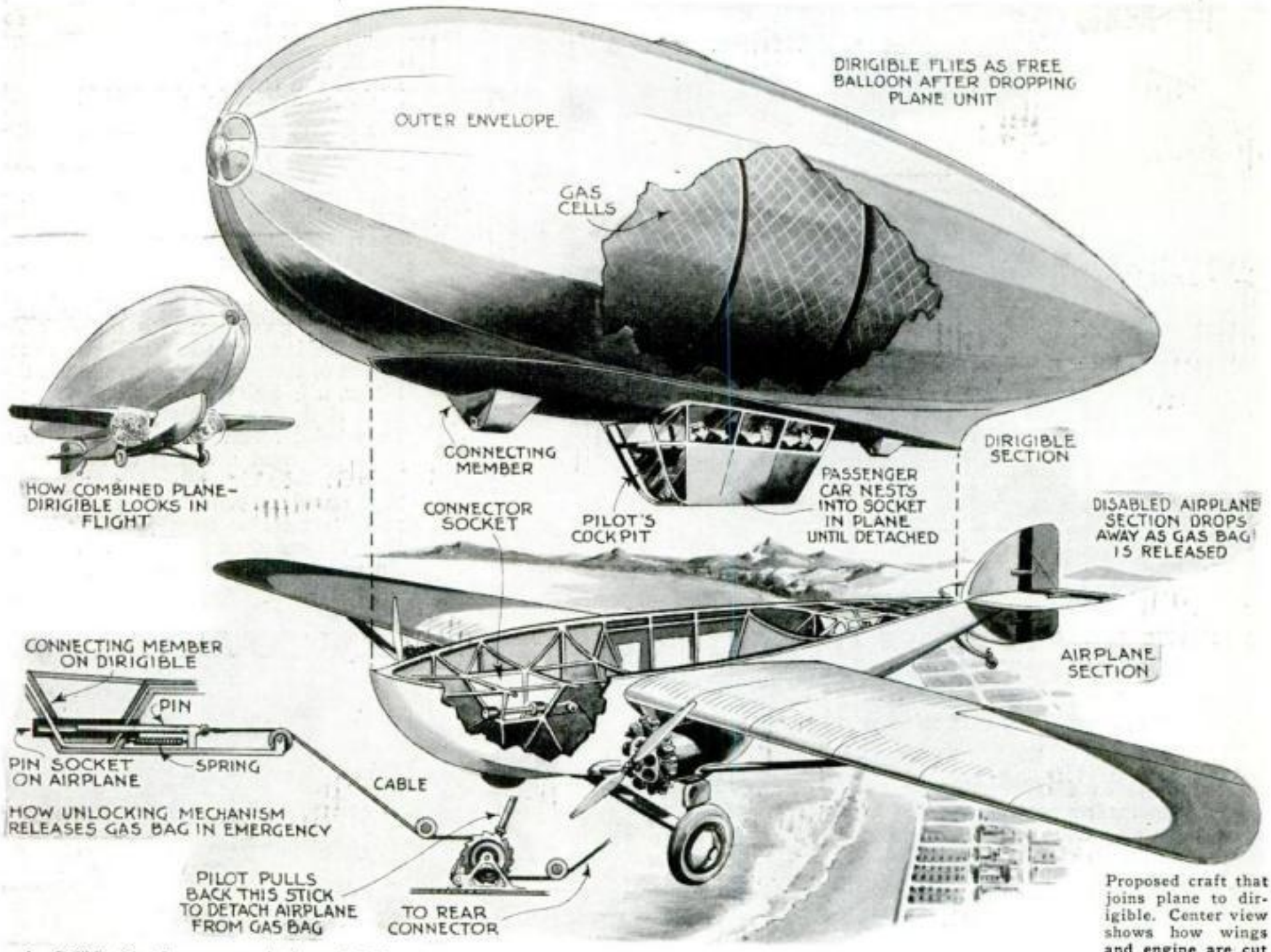


Above, projector of skywriting machine. At right, the ad on Empire State Building.

OUT of the darkness of New York City's night sky not long ago sprang a powerful beam of light that came to rest on the Empire State Building. The huge "spot light," ten or fifteen stories high, was an advertisement in luminous letters.

This was a demonstration of the skywriting sign invented by H. Grindell-Matthews, British scientist. The searchlight came from what looks like the framework of an oil-well derrick. At the end of the framework is a lens that acts like a magnifying glass on the rays of the searchlight. These passed first through a stencil on which the advertisement was cut out.

Plane Hooked to Dirigible to Get Safe Aircraft



Proposed craft that joins plane to dirigible. Center view shows how wings and engine are cut free in emergency.

A BILL for the appropriation of $50,000 to construct a strange hybrid aircraft, half dirigible and half airplane, was offered in the last Congress. After a hearing, the Army Air Corps was directed to test its possible military value before action was taken on the proposed appropriation.

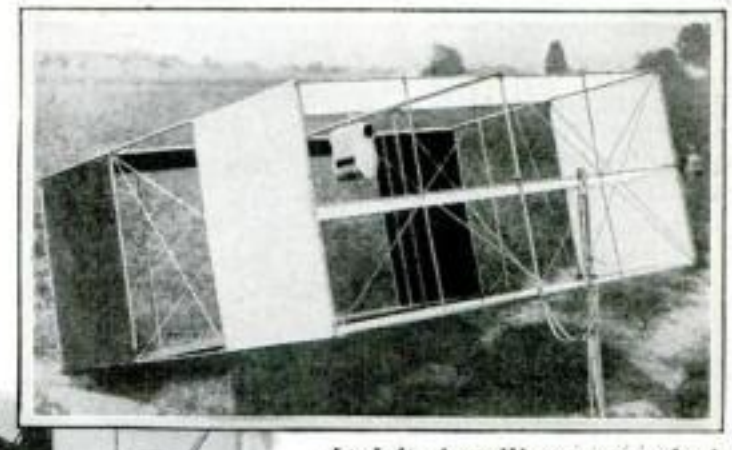
Meanwhile the inventor of the unusual airship, George W. Hardin, a county public school superintendent of Greeneville, Tenn., told POPULAR SCIENCE MONTHLY that his craft was a vehicle of many uses. A personal, or family, model would carry a commuter safely and swiftly between his home and his job, and take his family on week-end jaunts. Other models would carry freight, troops, or mail at 100 miles an hour.

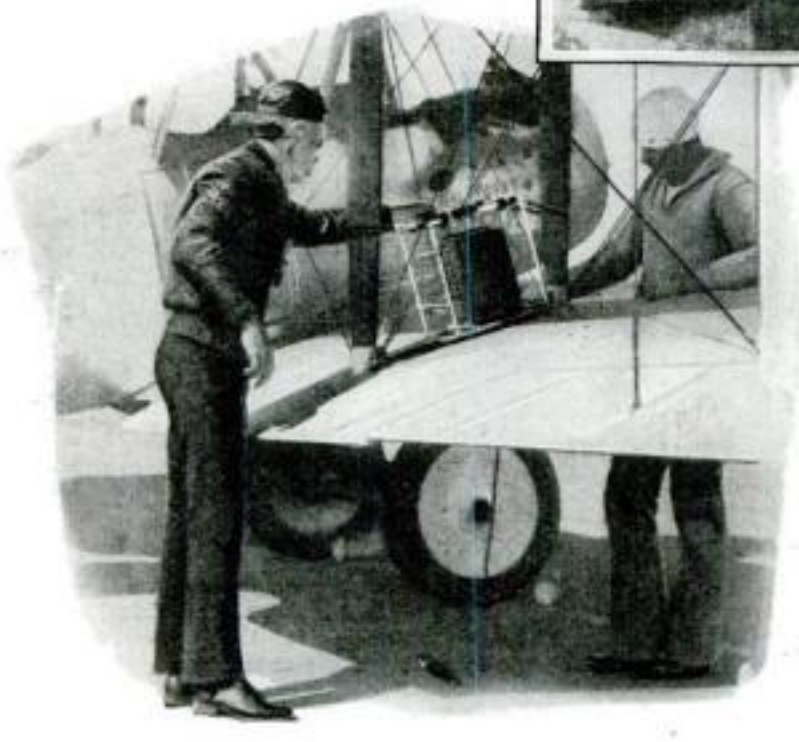
Pilot and passengers would ride in the upper, or gas bag, part of the machine. Should the airplane or lower section run out of gasoline, or its motors fail, a forced landing is unnecessary. The pilot pulls a lever that drops off the airplane section, as shown in the diagram, and the gas bag floats away like a free balloon. In normal forward flight the wings give added support and maneuverability.

Hardin is not an aeronautical engineer and as a result, he says, there doubtless are technical flaws in his plans which the Army experts could correct. At present it is intended to make the gas bag just large enough to lift pilot and passengers —thus forming a sort of aerial lifeboat.

WEATHER MEN TO DISCARD KITES

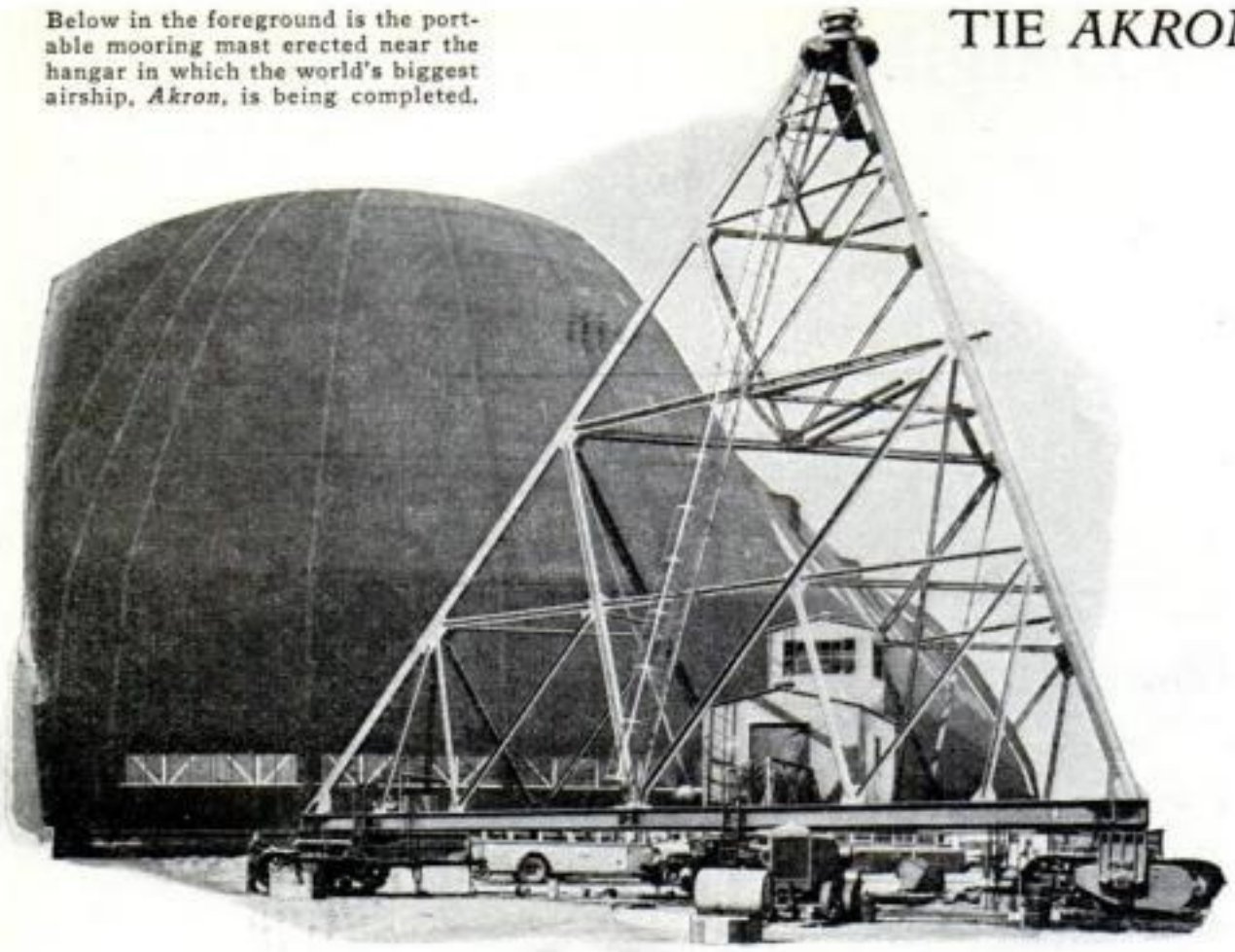
PLANS calling for the use of airplanes instead of kites in ascertaining conditions above the earth are being made by the United States Weather Bureau. Experiments to determine the value of the idea are under way. Planes equipped with self-registering instruments to record conditions of free air will make daily flights. The Naval Air Corps and some commercial air transportation companies have blazed the trail in obtaining weather data with planes. The fact that the method is practical has thus been demonstrated. Unusual significance attaches to the exit of the old-fashioned kite, since it has functioned satisfactorily for thirty years.





At left, installing meteorological instruments in airplane with which Weather Bureau plans to replace usual kite, above.

Below in the foreground is the portable mooring mast erected near the hangar in which the world's biggest airship, *Akron*, is being completed.



TIE *AKRON* TO MOVABLE MAST

AN ODD-LOOKING self-propelled vehicle is the portable mooring mast that will do away with ground crews for "walking" the U. S. S. *Akron*, world's largest dirigible, in and out of the titanic hangar in which she is being built at Akron, Ohio. The spidery pyramidal structure, eighty-five feet high, is carried on three caterpillar treads—two for propelling it and one for steering. It is driven by electricity, supplied by a gasoline engine driven generator carried in a central housing. This also contains the airship mooring winches.

A light steel ladder fixed to the side of the tower gives access to the dirigible when she is moored to it. For the protection of those who may have to use the ladder, it is inclosed for its entire length in a steel cage. This prevents people from being blown off it in high winds, and gives them a feeling of security as they climb its eighty-five feet on slender steel rungs and narrow sidepieces. This portable mooring mast is much larger than the one used for the U. S. S. *Los Angeles*, which has to be towed.

FLYERS JUMP TO ESCAPE DEATH AS BOMB BURSTS

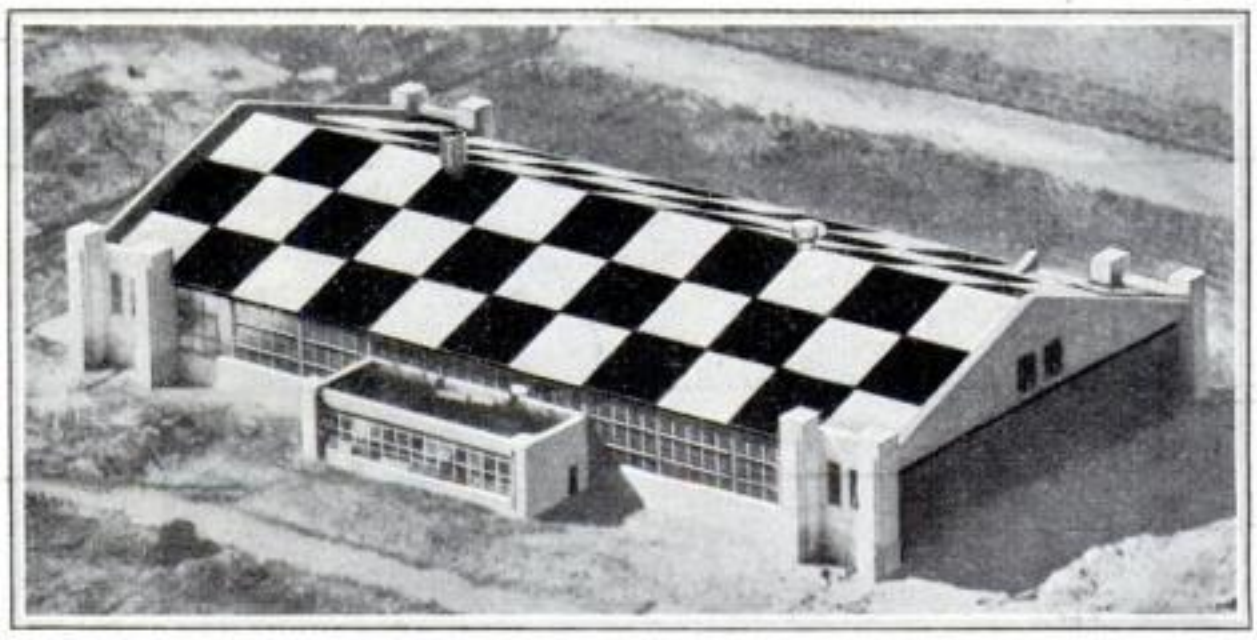
PRACTICING bomb-dropping near Langley Field, Va., two Army airmen released their last two missiles but no bombs fell. Looking over the side, the pilot saw the bombs caught in the plane's undercarriage. Loop-the-loops and spins failed to shake them off. Over the side went the two men with their parachutes. A few seconds later, there was a terrific explosion. The airplane was blown to bits.

TRUCK MOTOR POWERS HOMEMADE PLANE

THE motor that once drove a 1919 model flivver truck on Hugh Zimmerman's farm at Omega, Okla., now runs the farmer's airplane. Zimmerman became interested in aviation and built his own plane without professional assistance. For motive power he took the engine out of his old light truck. Then he taught himself to fly by first taxiing over the ground without wings, and then taking short hops with wings in place. Now he flies his children to school.

Above, Hugh Zimmerman, Omega, Okla., at work on his homemade airplane. At left, truck motor from an old discarded car that he salvaged and put to work driving the plane in which he makes flights with his children, flying them to and from school.

PAINT SQUARES ON ROOF TO AID PILOTS



Roofs of the buildings near the Army's new flying field, at San Antonio, Texas, have been painted in big checkerboard squares of black and yellow to increase their visibility and aid pilots.

AIR crashes in landing and in taking off at Randolph Field, the Army's largest and newest flying field, at San Antonio, Texas, are rendered less likely by painting huge checkerboards on the roofs of buildings surrounding the air field. Mammoth squares of black and yellow, selected as the most desirable design by Army experts, increase the visibility of the roofs from aloft and serve to mark the boundaries of the field as well as to warn airmen of the danger of crashing into the roofs in coming in for a landing.

GALE TESTS PLANE

WIND roared at a four-mile-a-minute pace through a new wind tunnel erected at the California Institute of Technology not long ago. The high speed was reached in a test. A 200-mile wind is sufficient to test any airplane model, and this speed is used ordinarily.

STREAMLINED AIRPLANE TIRE REDUCES FRICTION

STREAMLINED tires for airplanes, that cut the air as the bow of a ship cuts water, are a recent product. The new tires are roughly triangular in cross-section, with their treads forming an apex or point of a triangle. They are clamped to wheels of special design by demountable rims, making the job of changing tires quick and easy and preventing the tire from sliding when brakes are applied suddenly or landings made with heavy loads. They carry but ten pounds of air.

The outer face of the wheel is unbroken by any hub projection, and the tire fits snugly to the rim. Thus, when a tire is mounted on a wheel, there is a gentle curve from its pointed tread to the hub, giving a shape something like what you would have if you held two saucers with their upper rims joined. The wheel is larger in diameter and width than airplane wheels now in use, making room for larger and better brakes within it.

FIRST AIR AMBULANCE BUILT FOR ARMY

First ambulance airplane has been built for the U. S. Army. Note red cross on its side. At top, a patient being taken aboard the air hospital which accommodates fourteen, including doctor.

GRACEFUL as a bird of mercy is the U. S. Army Air Service's new flying ambulance, said to be the first plane constructed especially for this purpose. Painted a gleaming white, the big Fokker hospital ship bears a broad red cross, painted on her side. Twelve patients, as well as doctor and attendant, can be carried in her cabin. The pilot sits in an open cockpit on top of the fuselage, a short distance behind the wing. The plane is a single-engined monoplane.

FIRE EXTINGUISHER FOR PLANE IS AUTOMATIC

AN ELECTRIC flame detector is the brains of an automatic fire-extinguishing system for airplanes, demonstrated recently by its inventor, Robert Irving, at Roosevelt Field, N. Y. It works on the principle that an electric flame conducts electricity.

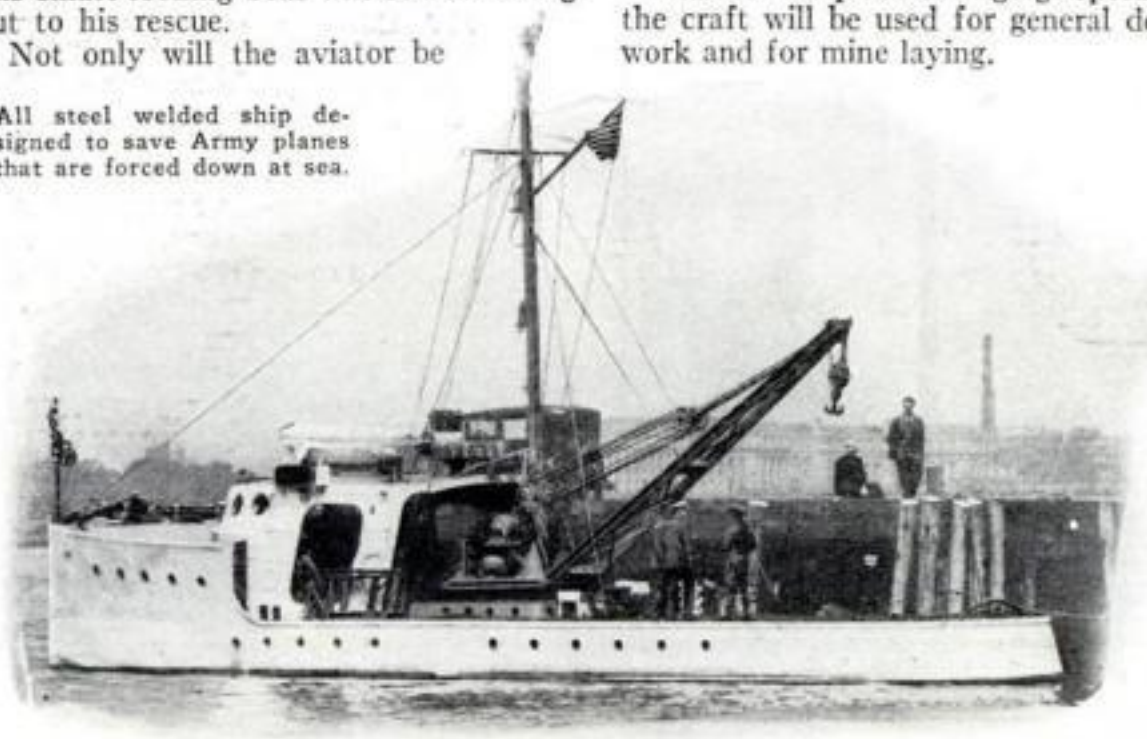
Pairs of electrodes, placed at strategic points in a plane, would be short-circuited the moment they were wrapped in flame. Instantly the extinguisher would go into action, spraying a chemical that puts out the flames. The whole apparatus weighs only twelve pounds, and in appearance resembles a small radio receiving set.

ARMY HAS SHIP TO SAVE PLANES AT SEA

A SPEEDY white craft with the high flaring bows of a torpedo-boat destroyer is the United States Army Air Service's new airplane rescue vessel, *H-1*. She has been designed and built for use in Panama waters. Should an Army aviator come to grief while flying over water, this smart-looking boat will come dashing out to his rescue.

Not only will the aviator be saved, but special equipment on the *H-1* enables her crew to salvage his plane as well. A crane amidships with a long boom will haul the plane aboard, if it is too badly damaged to tow. The *H-1* is built of welded steel, and is sixty-four feet long, driven by Diesel engines.

Besides its plane-salvaging operations, the craft will be used for general derrick work and for mine laying.



All steel welded ship designed to save Army planes that are forced down at sea.

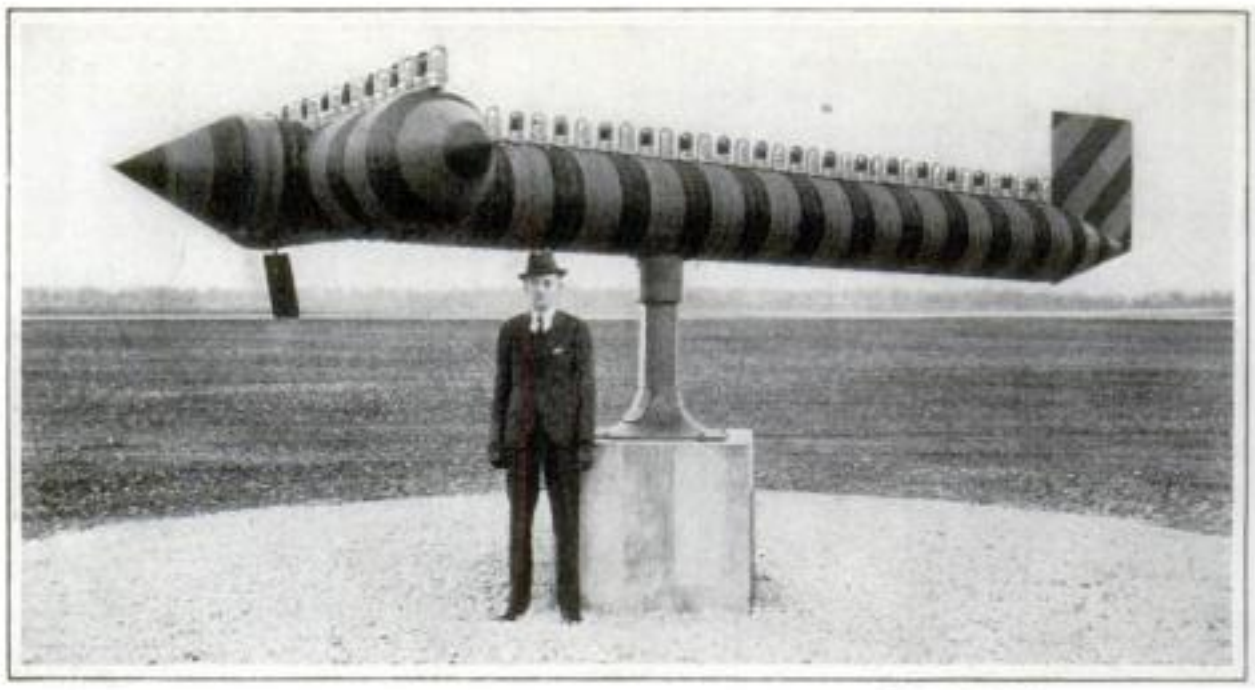
NEW SET OF INSTRUMENTS GIVES PLANE FULL TEST

A NEW set of airplane instruments makes a compact test kit for trying out a plane's airworthiness. It is mounted as a single unit in a small portable casing. This "portable instrument board" is designed to be worn strapped to the knee of a Department of Commerce inspector as he checks planes for their certificates. It will indicate take-off time, gliding speeds, stalling speeds, rate of climb, and ability of multi-motored ships to maintain altitude with one engine cut out.

PISTOL GRIP SAW SET POUNDS TEETH IN LINE

A NEW saw set that works as easily as firing a pistol is expected to prove a convenience for carpenters and woodworkers. A small anvil is attached to a pistol grip. Light pressure on a trigger draws a hammer back and compresses a spring. When the hammer is released the spring drives it against a tooth of the saw held in front of the anvil. An adjusting screw increases or decreases the force of the hammer's blow. Though small, light in weight, and easily carried in a tool box, it does as good work as large factory machines.

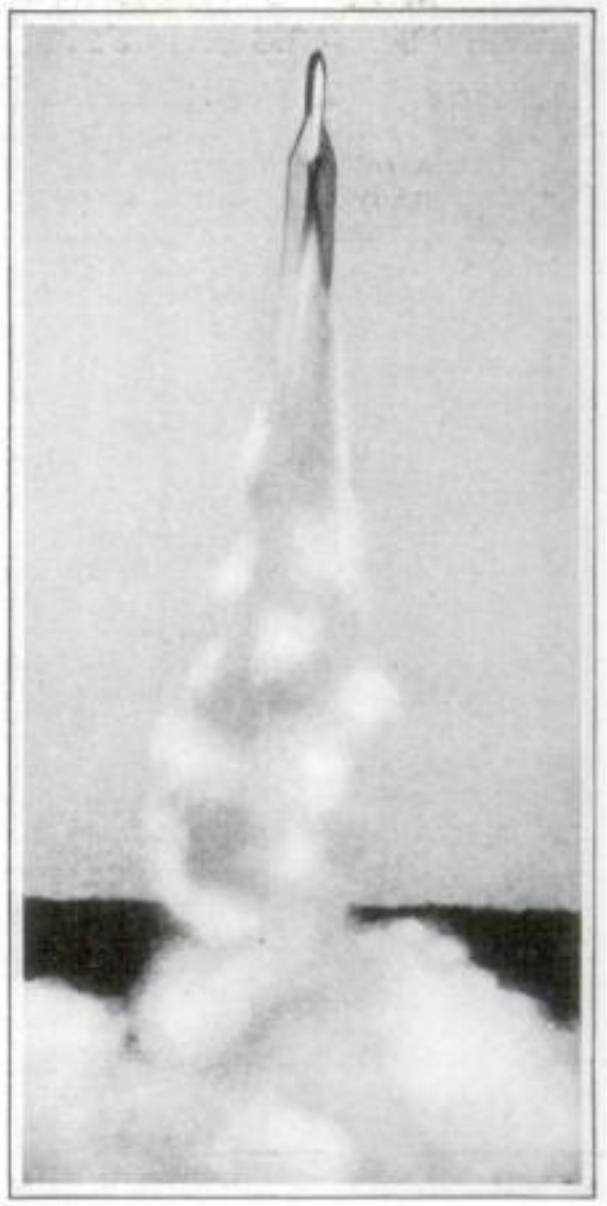
New saw set with hammer worked by a spring aligns teeth with carefully controlled blows.



"T"-SHAPED WEATHER VANE AIDS FLYERS

TO AID flyers about to land, a Chicago manufacturer has designed an enormous weather vane. In bringing his plane down the pilot must know the direction and strength of the wind on the field below him. He gets this information from the new vane built in the shape of letter "T" rotating on ball bearings and topped by colored electric lights for night flyers.

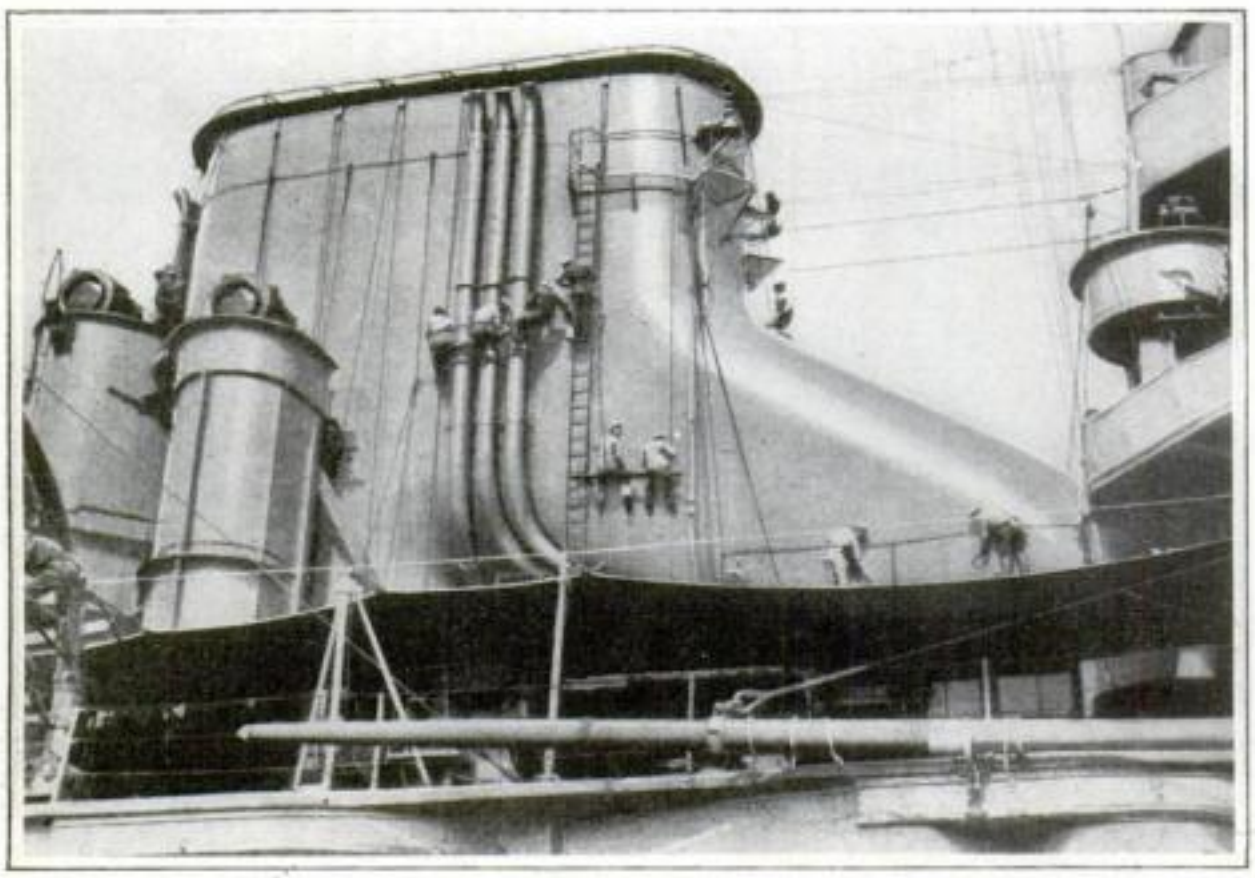
A vertical fin at the tail swings the crossbar into the wind. A small flapper, hanging below it and actuated by the wind, works a series of contacts that turn different lights on or off. These tell the pilot the strength of the ground wind.



GIANT SHOE IS BIG WARSHIP'S FUNNEL

THE picture below shows what looks like an enormous shoe, but it takes a lot more cleaning and polishing than does any real shoe. Seamen of H.M.S. *Warspite*, one of Britain's larger battleships, swarm over the big sea fighter's shoe-shaped funnel, putting a "shine" on it. Slung in bo's'n's chairs and on swinging scaffolding, they dangle down one side of the enormous smokestack like flies on a wall, giving it a new coat of gray paint.

Smoke flues, from two separate sets of boilers far below decks, brought up above the deck level before being joined together, give this great smokestack its shoelike appearance. Had they been united below decks it would have been necessary to pierce a great hole in a water-tight bulkhead, besides taking up valuable room inside the ship needed for other purposes.



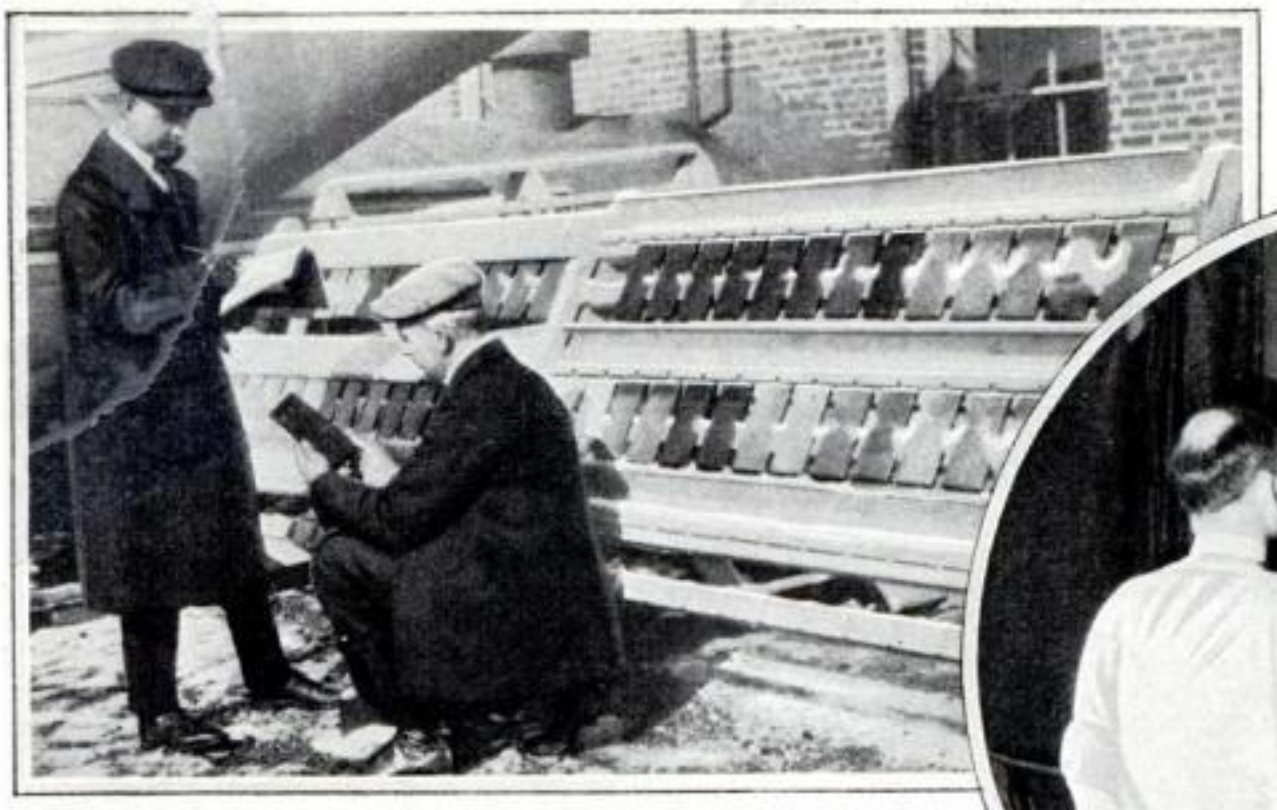
Smoke flues from separate sets of boilers far below deck are joined together above deck to form this shoe-shaped funnel. British seamen are here seen giving it a new coat of gray paint.

MAIL ROCKET IN TEST RISES 6,500 FEET

Two hundred spectators in a field near Osnabruck, Germany, were startled by the roar of explosives as the first mail rocket leaped into the air. They saw it flash straight upward out of the cloud of smoke and in a few seconds fade from sight. In this test the rocket carried only a few postal cards. The five-foot model that was used reached an altitude of nearly 6,500 feet. When it began to fall, a pair of wings automatically unfolded, and it glided gracefully to earth.

Engineers dream of shooting mail across the Atlantic in a few hours by means of giant rocket planes. Such craft would soar into the thin layer of air surrounding the earth at a height beyond the reach of present planes. Flying in this layer, called the stratosphere, they hope to attain speeds impossible for aircraft of today.

Amazing *New Paints* Found by Chemists



These weather exposure racks are used by experimenters to test the effect of sun and rain on the panels coated with new kinds of paint.

In order that color standards may be maintained at absolutely a constant shade, the photometer, which measures color by light, is used. Each new batch of paint must be thus tested.

Old Slow-Drying Pigments Go in Discard—Special Coverings Now Manufactured for Special Woods

By MARSHALL ANDREWS

WHEN a contractor's workmen painted the White House at Washington recently, the Presidential mansion received something like its sixtieth coat in 116 years of white lead, oil, and dryer. This paint, unlike that which covers your house, if it is made of wood, and the interior woodwork at any rate, serves a decorative purpose only.

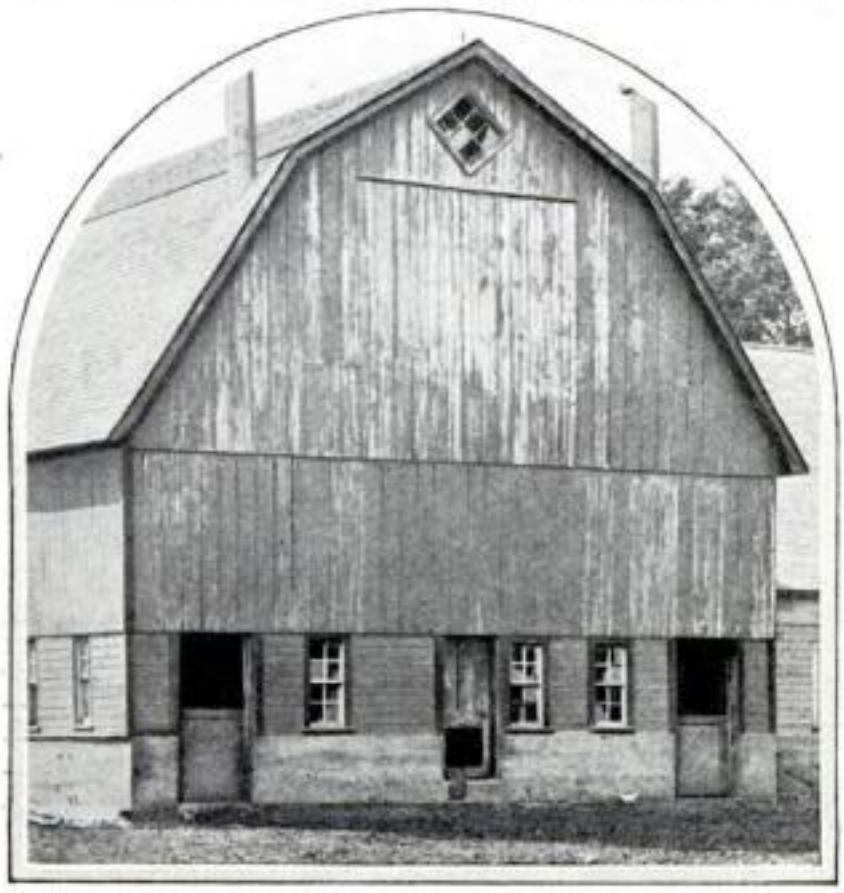
Modern house paint, however, must perform many functions in addition to the one of merely making the building look nice. Foremost is protection, and each year science is finding an increasing number of ways in which paint can be made more effective in preserving wood.

Still, the decorative function is not forgotten. Paints today come in more colors and shades of color than ever before. The application of paint has, in recent years, been undergoing a revolution as a result of the new facts about paint that have been discovered in a thousand laboratories.

Quick-drying lacquers, made possible by the use of butyl acetate, are common. A paint manufacturer recently has discovered a secret formula by which house paints dry as quickly as lacquers.

Paint is most important for its moisture resisting properties. The improvement of these has long occupied chemists. Unceasing research in laboratory is making paint handsomer, hardier, easier to manufacture and apply, and with a greater moisture resisting quality.

Some of the most important work with paint now being done is that of the United States Forest Service in its laboratories at Madison, Wis., and by field workers all over the country. The Institute of Paint and Varnish Research, maintained by paint and varnish manufacturers at Washington, D. C., and presided over by H. A. Gardner, also is constantly studying the problem. Practically all of the more than 300 paint manufacturers maintain chemists in their own plants, who are constantly seeking to improve individual products.



An example of what happens when wrong paint is used on the wrong wood. Failing to stick properly, it flakes and falls off.

Perhaps the most notable recent discoveries in the field of paint have been those of the Forest Service in connection with the needs of special paints for special woods and with the use of metal as an ingredient in waterproofing paint.

PAINT must not only protect wood from the weather, but it must itself be protected from the wood. Strangely enough, the coating of paint that adds years to the life of a wooden structure suffers constant attack from the material it protects. Chemical constituents of the wood, the wood texture, and moisture absorbed by the wood and conducted by it to the paint all contribute to the breakdown of the protective coating.

Everyone has seen paint on the side of a house accumulate small blisters which, when broken, are found to contain a dark colored liquid. As soon as this broken blister has dried, the loose paint

Paint is being applied to this house not only for beauty, but also to end weather ravages.

hardens and falls off, leaving the wood exposed.

These blisters are caused by the moisture in the wood. Blisters on the sunny side of a house are not caused by the action of the sun on the paint. They are the result of the sun's heat vaporizing water in the wood. The expanding vapor pushes the paint away from the wood, and there is your blister. For that reason, according to F. L. Browne, senior chemist at the Forest Products Laboratory of the Forest Service, a southern exposure is not always the best for house paint, even though it may be considered best for the house.

FURTHERMORE, a house built in the fall or winter usually will not hold paint as well as one built in the summer or spring. The reason is simple. Houses built in the cold months are more likely to be exposed to moisture from rain or snow while under construction. Also, the house is usually heated from the inside as soon as it is built, causing a wide difference in temperatures among the wooden parts of the structure. These differences are naturally conducive to the collection of moisture.

Often mold is found to have accumulated on painted wood under conditions of dampness. Painting will not relieve the situation, according to Browne.

"Paint is not itself toxic to fungi," he told me. "In fact, a few fungi can even use it as food. It is essentially a surface coating that only slightly penetrates wood. Even if a coating entirely impervious to the fungus spores were constantly maintained over the surface of the wood, the infection is almost certainly present in the wood to begin with. The influence of a paint or varnish coating on decay is, therefore, a question of moisture content."

Taking a leading part in the fight against wood decay through the use of paint in combating moisture come experiments that have been conducted since the World War with various metal ingredients. During the war days of frantic production, the tendency of damp airplane propellers to warp caused much trouble. At that time, chemists devised the method of coating the wood with aluminum leaf which, until recently, was the most effective known.

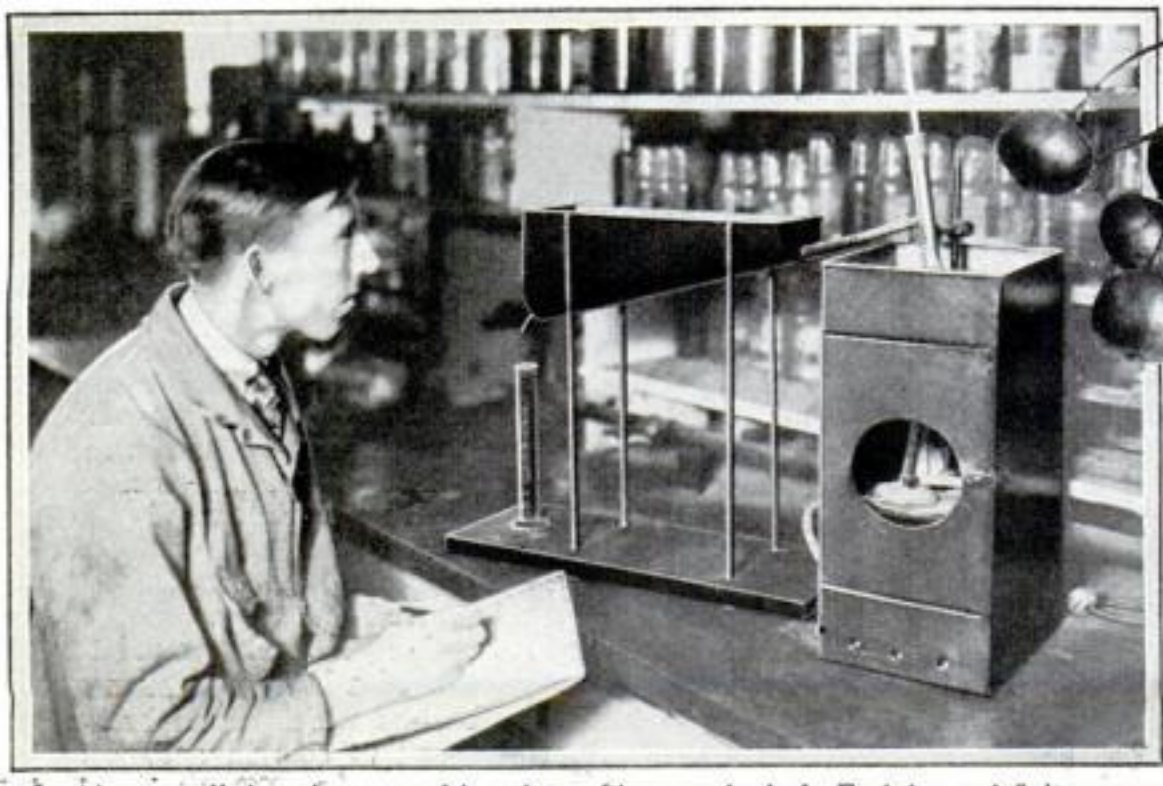
NOW, however, following exhaustive experiments in which eighty-four different types of coatings were used, George M. Hunt, principal chemist of the Forest Products Laboratory, has announced that a coating containing aluminum powder as the principal moisture resisting ingredient has been found the most satisfactory. Not only does the use of aluminum powder result in a paint with a very high factor of moisture resistance, but it may be applied with either a spray or a brush.

In the long series of experiments included in this research, some of the wood panels were electroplated with copper, covered with vulcanized rubber, enameled, coated with bakelite, or incased in riveted metal. A few of the coatings proved to be more resistant to moisture than aluminum powder, but expense, difficulty of application, and other considerations rendered them impractical from a commercial standpoint.

Balky doors, stuck windows, warped and cracked floors, and teetering chairs and tables are the results of changes in the shape of wood caused by moisture. The use of aluminum paint, impregnating the woods with *(Continued on page 130)*

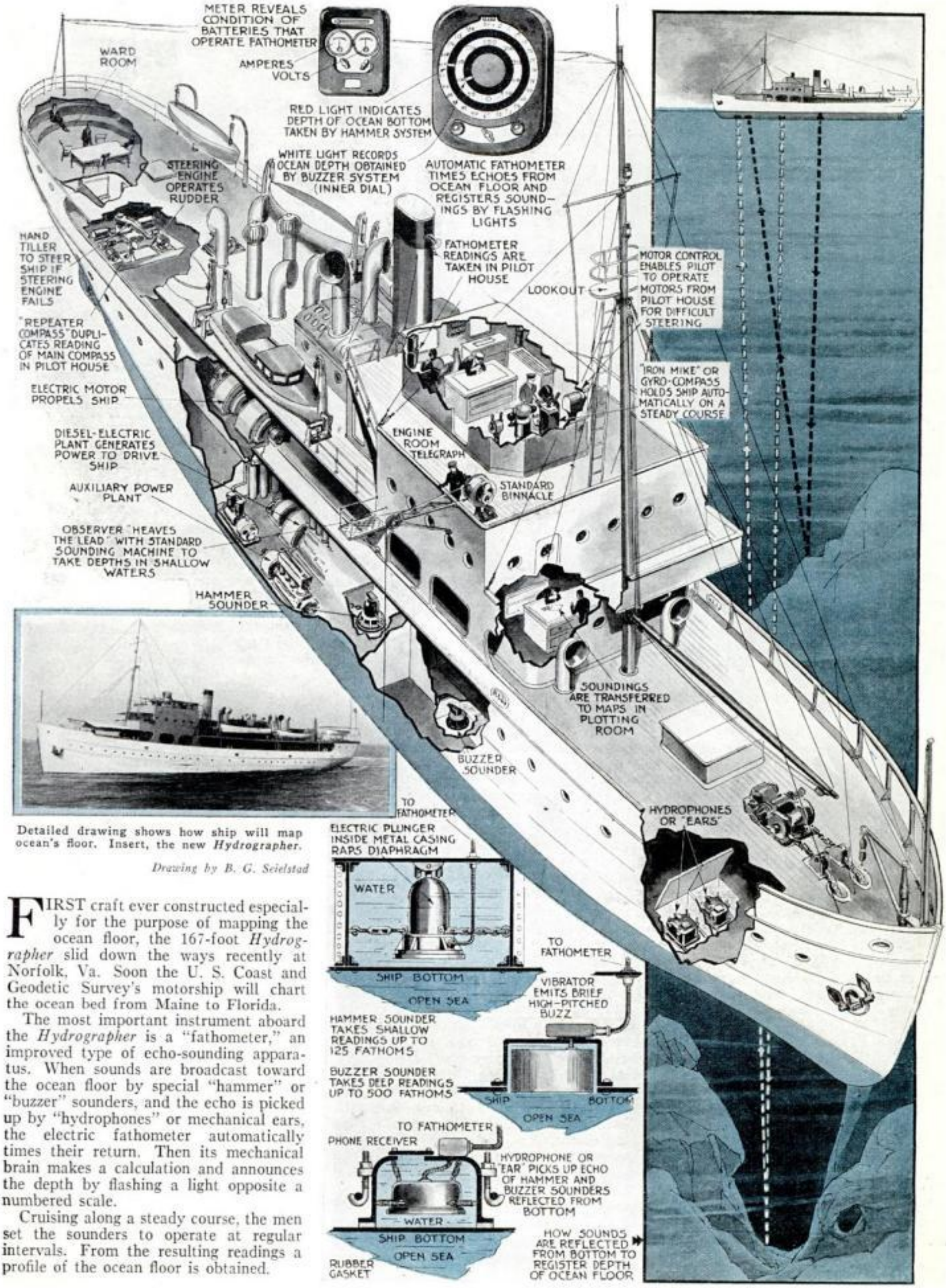
Much paint is now sprayed on, a method made possible by new ingredients.

The use of tung oil in paint has given America a new industry, and this tung oil fruit was all grown in United States.



In this room all the solvents used in paint making are checked. Each has a definite range of distillation and tests are made to be sure temperature reactions are within the range.

New Ship to Map Ocean's Floor



Detailed drawing shows how ship will map ocean's floor. Insert, the new *Hydrographer*.

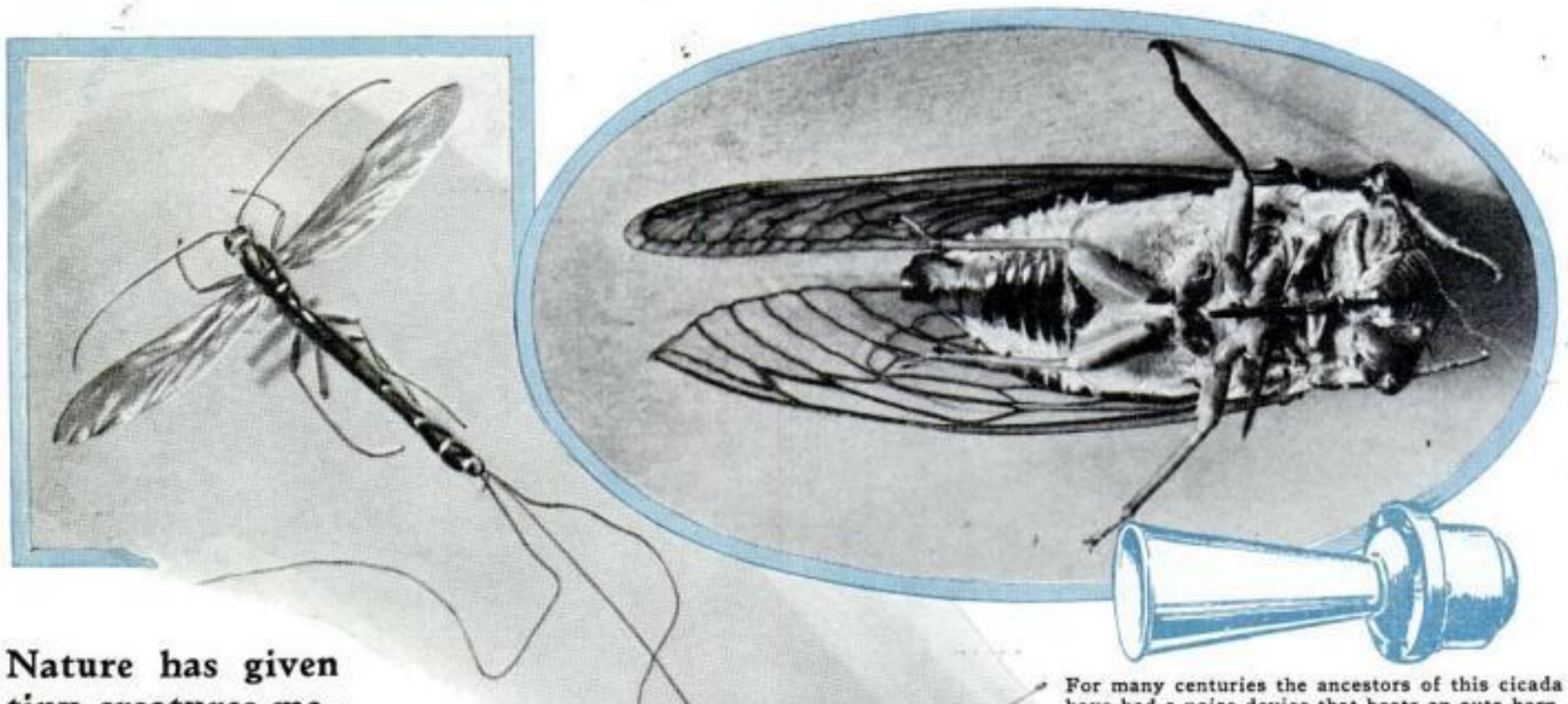
Drawing by B. G. Seielstad

FIRST craft ever constructed especially for the purpose of mapping the ocean floor, the 167-foot *Hydrographer* slid down the ways recently at Norfolk, Va. Soon the U. S. Coast and Geodetic Survey's motorship will chart the ocean bed from Maine to Florida.

The most important instrument aboard the *Hydrographer* is a "fathometer," an improved type of echo-sounding apparatus. When sounds are broadcast toward the ocean floor by special "hammer" or "buzzer" sounders, and the echo is picked up by "hydrophones" or mechanical ears, the electric fathometer automatically times their return. Then its mechanical brain makes a calculation and announces the depth by flashing a light opposite a numbered scale.

Cruising along a steady course, the men set the sounders to operate at regular intervals. From the resulting readings a profile of the ocean floor is obtained.

Insects Beat Man As Toolmakers



For many centuries the ancestors of this cicada have had a noise device that beats an auto horn.

Nature has given tiny creatures mechanical means for sawing wood, drilling in rock, making loud noises, and producing a cold light. Also their manner of communicating is subtle and is now being carefully studied.

By
WALTER E. BURTON

PUT a new horn on your automobile, and you will have a lot of fun listening to it, and realizing it can be heard a half-dozen blocks away.

But you would not feel so proud if you knew that a certain cicada, erroneously known as a seventeen-year locust, was thinking as he watched you go by, "Shucks, that fellow thinks he has something. Why, my ancestors were sounding more efficient horns than that when the Garden of Eden was in blossom, and doing it much better."

The cicada, one of the thousands of pioneer inventors in the insect world, long ago developed a noise-making device that can be heard a mile away. Inside the insect's body is a system of specialized chambers and membranes connected to two plates or drumheads on the underside of the body. By muscular action, these plates are vibrated and the sound produced. No automobile horn, radio loudspeaker, or other man-made device ever worked more efficiently.

But that is only one example of strange insect mechanism. You could operate a complete workshop equipped only with insect tools!

The well-organized shop has equipment for making holes in wood and other materials. There are several natural drills among insects. For very small holes you could use the ichneumon fly. Females of this species have an egg-laying tube that is four and one-half or more inches long.

At upper left, the four-and-a-half inch drill of the ichneumon fly. With this it digs a hole in a tree in which to lay its eggs.

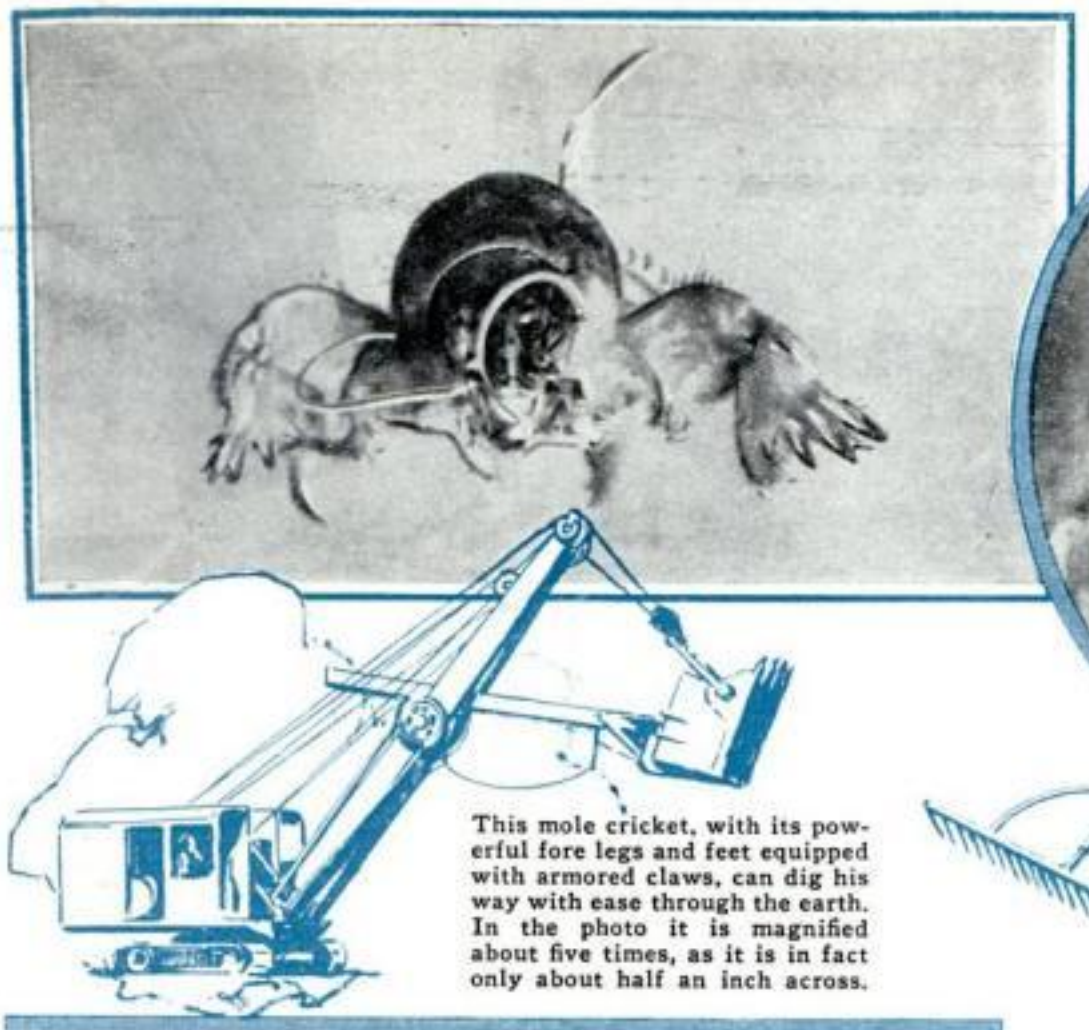
Selecting a tree, it drills a hole to a depth of about four inches.

The egg tube has on its end a set of fine, sharp teeth that cut even the hardest tree as the tube is moved back and forth like a file. By selecting assorted sizes of ichneumon flies, you could have a complete set of miniature drills!

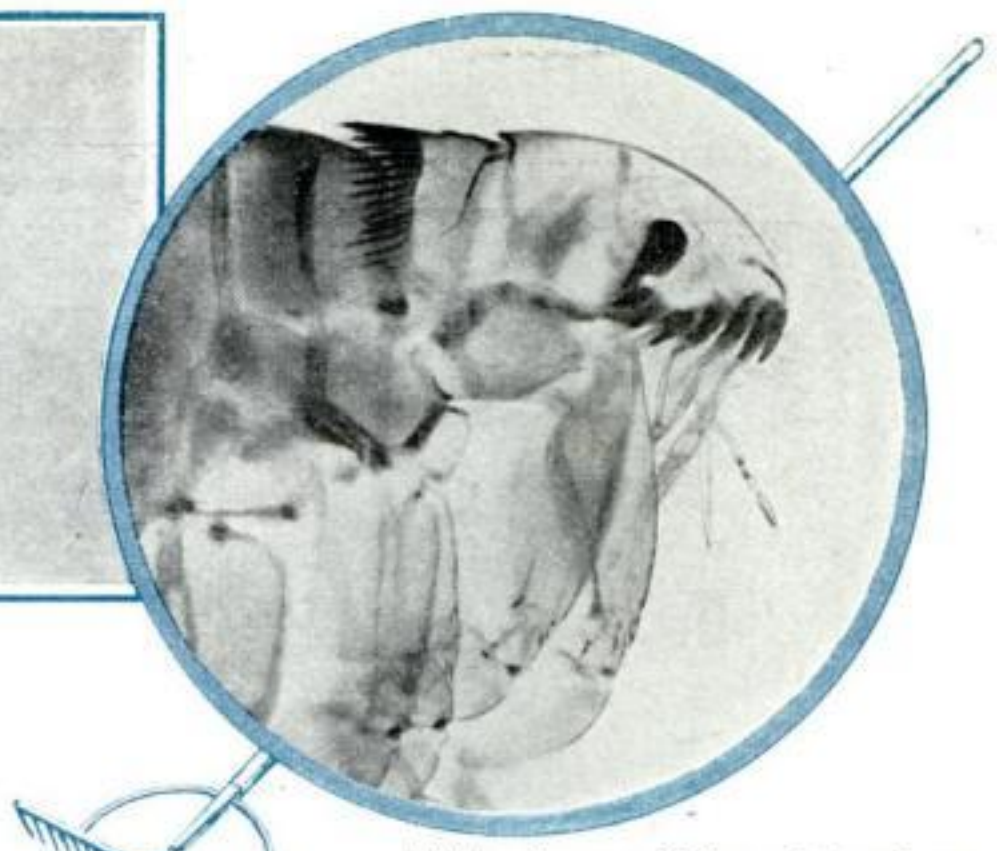
FOR larger holes there are other efficient boring machines. Certain beetles have drills that they use for making holes in acorns so that they can lay eggs in them. For half-inch holes, you could use a carpenter bee. The female carpenter bee, preparatory to laying eggs, drills a half-inch hole twelve or fifteen inches deep into a dead tree or post.

If you may want to drill something harder than wood, use the grub of a horntail sawfly. After it is hatched, the sawfly spends a long time inside the trunk of a tree, boring holes with its powerful jaws. Then, some day it decides to go outside. If, in the meantime,

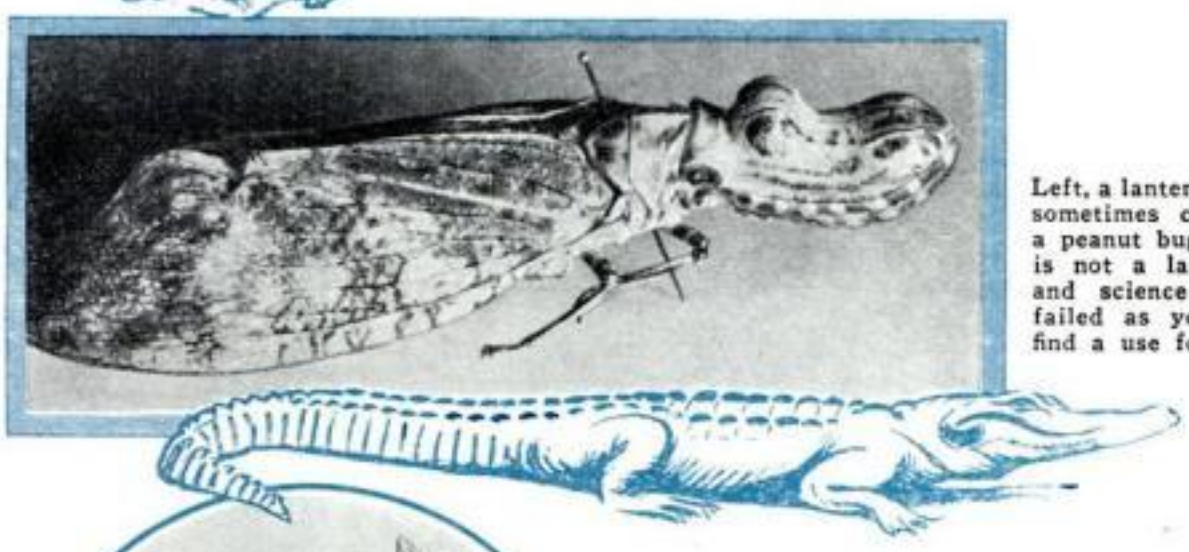
Center right is the trapdoor spider and below that is the door itself tied open with a silken cord while the spider is away. Then a man-made trapdoor of the same general kind.



This mole cricket, with its powerful fore legs and feet equipped with armored claws, can dig his way with ease through the earth. In the photo it is magnified about five times, as it is in fact only about half an inch across.



This flea, here magnified several times, loves to live on cats and scrape them with its rake.



Left, a lantern fly, sometimes called a peanut bug. It is not a lantern and science has failed as yet to find a use for it.

Photos Courtesy U. S. Department of Agriculture

As a protective device, developed during the hard struggle for existence, this chewed-leaf bug has an instinct to imitate a leaf group that has been chewed to an irregular shape.

someone has cut the tree down, made it into a beam, and sheathed it with lead; the grub hesitates only long enough to bite through the tougher substance. For drilling rock, there is a certain ant that makes a tunnel through a foot of solid stone.

Other boring machines might include tiger beetles, May bugs, locusts, mole crickets, and so on. If you want a sawing machine, you can go again to the sawfly, which has an efficient mechanism for sawing grooves in dead trees. Its two saw blades, side by side, work alternately back and forth so there is little strain on the insect's body. When not in use, the blades fold into a recess, just like a pocketknife. An inventor might study this fly and profit by producing an entirely new type of power saw as a result.

JOHN C. PALLISTER, entomologist of the Cleveland Museum of Natural History, told me the following story:

A contractor erected a building in Cleveland. A short time after he had completed it, the owner came to him with a complaint that the roof was leaking. Examination revealed half-inch holes neatly drilled in various places through the asphalt coating and boards beneath. Recent labor trouble was thought to have caused some of the contractor's enemies to do the drilling. Then, when work of replacing the roof was started, someone noticed a beetle emerging from one of the holes.

The insect was captured and taken to Pallister, who identified it as a type of insect found in southern countries. Its mother had laid her eggs in the pine tree that later became a beam in the building. The larva, after reaching maturity, had sought the outside world by boring through part of the beam, the sheeting boards, and the asphalt layer.

NO MAN-MADE drill compares in efficiency with that of the ichneumon fly. The front feet and legs of the mole cricket rival the steam shovel. The spider, by employing sound engineering principles, can raise weights many times as great as that of its body. The spinarettes of a spider form a complete silk-factory, and the product is stronger than man-made fibers of the same sort.

For ages insects have been using chisels, pincers, punching machines, hammers, spades, awls, hypodermic needles with which to administer anesthetics, measuring instruments, sewing machines, glue, cement, silk underwear, armored suits, shingles, paper, cardboard, and scores of other things that man, a newcomer, proudly thinks he invented or discovered.

ALTHOUGH a great many of the insects and spiders are content to go about in the clothes that Nature gave them, others construct robes in which to stay.

The oak tortrix is an ingenious tailor and builds its overcoat out of a leaf. Using one that has a slightly curled edge, he runs a silken thread from this edge to a point on the opposite edge, drawing the line taut. Then he constructs numerous parallel threads. By weighing down one or more of these cross threads, he causes the remaining ones to hang slack. These he tightens, then takes up the slack in the ones with the weight. The leaf, as a consequence, is rolled up a little. This operation is repeated until the leaf has been curled into a comfortable shelter in which the insect can hide.

If you examine, under a microscope, the needle that the honey bee carries for stinging, the *(Continued on page 134)*

Famous Sphinx's Face Lifted to Save Mighty Figure

Engineers in Egypt have repaired the Sphinx to keep head in place.

At left, workmen repairing huge figure. Above, Sphinx free of sand.

No longer is the Sphinx's head in danger of falling off. Engineers of the Egyptian government recently have been giving this world-famous figure a face-lifting treatment. The supporting headdress has been put back in place, and some of the worst gashes in the face have been eliminated.

This strange figure, with a human head and the body of a lion, was going to pieces. Six years ago, a party of tourists were startled by a loud crack. An enormous chunk of the headdress tumbled to the sand. When an inspection followed, other serious cracks were found. Erosion had cut deeply into the neck. Though the Sphinx's face still bears some marks of human and elemental depredations it is now safe.

In recent times the Sphinx has undergone radical transformations. For the first time in 3,600 years the huge figure became visible in its entirety three or four years ago when engineers removed the sand that had buried its lower half. Now it stands in the midst of a huge excavation, with the head towering as high as a five-story building above the huge 250-foot claws.

THREE COLORS IN FLASHLIGHT

A flashlamp that gives three colors of light by the simple operation of turning a knob at its top is the product of a Chicago, Ill., manufacturer. The knob moves a screen in front of the light, resulting in a red, green, or white beam. The flashlamp is lit by a push button on the handle as is any ordinary flashlight. A clip at one end allows it to be worn on the belt, or attached to a motor car as an emergency tail light.

STRANGE SCREW GIVES EGYPT WATER

With this primitive wooden screw, turned with a crank at the top, natives in Egypt raise water from the irrigation canals.

An unusual method of raising water from irrigation canals to fields is employed by Egyptian natives on the banks of the River Nile. They have rigged up a rotating screw about two feet in diameter inside a wooden cylinder about six feet long. One end of the device is placed in the canal, with the upper end projecting over its bank at the level of the field.

Turning a crank at the upper end of the screw shaft lifts water out of the canal. This method of raising water is said to be efficient for low lifts, and a similar device has been used in the Nile delta region for centuries.

With colored screens, this novel flashlamp throws out rays of red, green, or white light.

Earthquakes Made with Dynamite Find Hidden Fields of Oil

A TRIM little motorboat, with two odd-shaped masts carrying wires on crosstrees, glides into a Louisiana bayou and comes to rest. One of the crew lowers a metal globe into the water from the stern of the craft. A few minutes later, from a distance of a couple of miles, comes the muffled boom of a dynamite explosion. The globe is hauled up; the boat chugs on its way.

The strange behavior of its crew might puzzle an observer until he learned that these men are using the latest scientific method to hunt oil—by producing artificial earthquakes with dynamite blasts. They are oil prospectors for a great refining company, which has discontinued the old hit-or-miss fashion of hunting well sites. Recently it sent exploring parties through the Mississippi delta region of Louisiana and through two counties of southern Texas in a systematic search for potential oil fields.

The work in Louisiana was made difficult and arduous by the floods and swamps of the section under examination. A whole fleet of boats was used, including observation craft, a sea sled, and a dynamite barge, and where boats could not penetrate the observers waded knee-deep with seismographs on their backs.

The method used in the search is as follows:

A 500-pound charge of dynamite is planted at some point on land in the region to be explored. In a measured circle around this spot, at distances of several miles, parties take up their stands with seismographs, if on land, or with "geophones," underwater adaptations of these earthquake-detecting instruments, if on the water.

The men at the scene of the blast fire the charge of dynamite and broadcast, at the same instant, a radio signal to the distant observers. The radio signal reaches them instantaneously. Then they wait to see how many seconds the dynamite shock will take to reach them through the earth or water.

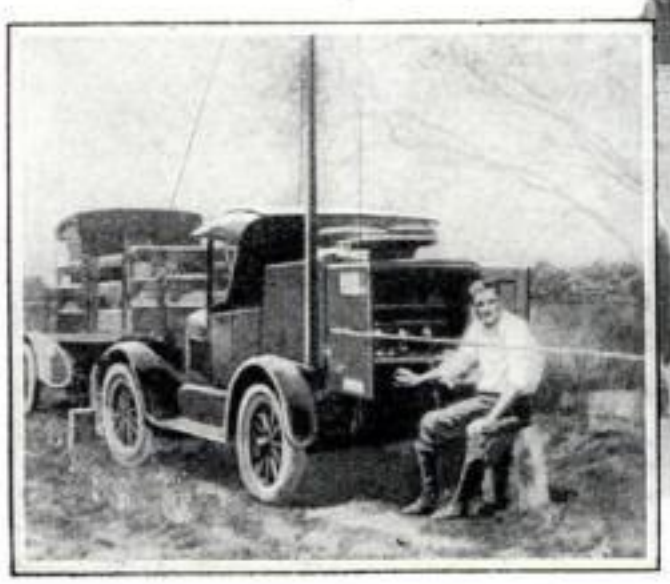
If one party detects the earth ripple long before the observers at equal distance from the blast in other directions, it is "warm" on the search for oil. The speeded-up earth waves show the presence of a "salt dome," or underground deposit of salt through which they travel more rapidly than in earth or rock, between the blast and the observing party. Oil men know that the chances are good to find oil near a salt dome.

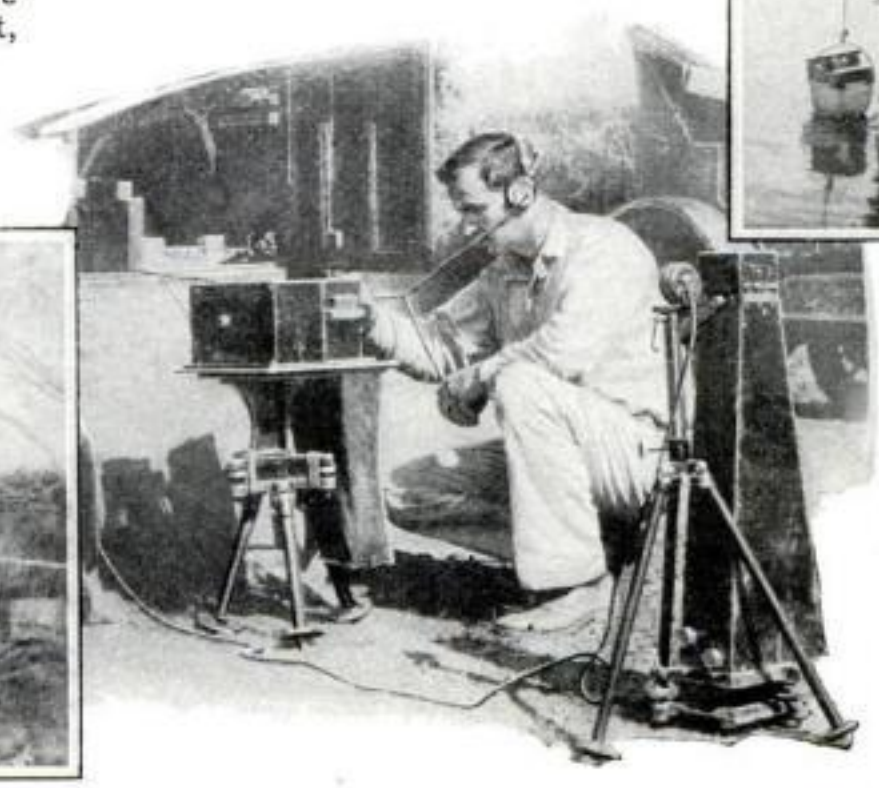
By repeated blasting, the best spot to drill is found.

Searching for oil in the swamp region of Louisiana, this boat carried a geophone out from shore to pick up vibrations from explosion.

Right, above, five hundred pounds of dynamite, exploded twenty feet below surface, starts vibrations that instruments pick up.

Above, from the stern of the boat shown in the oval, a geophone is lowered into the water. Its record of the movement of waves caused by blast is used to locate an oil field.





At extreme left, car with radio outfit and dynamite-bearing truck. As shot is fired radio signals give seismograph operators the time. At left, sensitive seismograph set up in field to catch the time required for waves to travel from point of detonation to instrument. Variation in rate of advance is indicative of a salt dome and probability of oil.

PLANS HOMES OF ALUMINUM AND GLASS

At left, proposed model home of the future with aluminum walls and glass through which the ultra-violet light can pass.

Below, Albert Frey, New York architect, is showing how the sheets of aluminum should be attached to walls of the house.

WILL the suburbanite of the future sit in his living room behind walls of aluminum, while sunbeams stream in through ultra-violet-transmitting glass? Two New York architects thus vision the ultra-modern home in the suburbs. A model three-story house built along the modernistic lines they propose was exhibited recently in New York City to a group of architects.

The outside wall is of sheet aluminum, backed with insulating material, only three inches thick. The metal is slightly corrugated to prevent reflection of sunlight.

A seventeen-foot window of special glass, which transmits ultra-violet light, occupies one entire side of the two-story-high living room. At night, neon tubes like those used in advertising signs supply illumination. Floors and beams are of steel throughout the house.

A library on the top floor, lighted by skylights, has a ceiling of aluminum foil. The rest of the upper story is given over to a sleeping porch and an inclosure that can be used for sun bathing.

LISTS FOUR WONDERS OF THE UNIVERSE

REVISING the wonders of the universe, Sir J. Arthur Thomson, British zoologist, suggests there are four of them. The first, he says, is the power that keeps stars and planets spinning on their axes. Immensity of space is the second. Third, the delicate mechanisms needed for the life of even the smallest of insects. The orderliness of Nature is fourth.

INSECTS THWARTED BY SCREENED CHAIR

FREEDOM from insect pests is guaranteed by a novelty among rocking-chairs. A frame surrounds the user and incloses him on all sides with screening. Flies and mosquitoes buzz harmlessly on the outside, while he rocks in comfort. The frame is collapsible for easy storage.

Thoroughly screened from mosquitoes and other pests, this folding chair is comfortable.

FOUR-FOOT DIAL SHOWS PHONE'S MYSTERIES

THE intricacies of using the dial telephone come easily to students at a western secretarial school, where a four-foot dial was recently rigged up to explain its mysteries.

Not a dummy, the big dial actually works. It is connected with two telephones, an amplifying apparatus, and a loudspeaker. When the instructor dials a number, the loudspeaker reproduces, so that all may hear them, the typical sounds that will be heard; and the instructor explains to the pupils what they mean.

MOTOR BIKES SPEED HOME REPAIRS

WHEN anything goes wrong in the house, from the furnace to the radio, a Los Angeles, Calif., resident has but to step to the telephone and at his call instantly one of a fleet of repair motorcycles will come whizzing to the rescue.

The organizer of this novel service first got together a large staff of experts in many household crafts and trades. Then he equipped them with speedy motorcycles.

The odd shape of the vehicles, patterned after bungalows, attracts attention as they speed through the streets and results in making his service more widely known. Each of the men employed is bonded and is thoroughly trained in his line as an electrician, radio repair man, plumber, carpenter, or expert in gas fixtures.

These motorized bungalows are used by experts in a Los Angeles corps of hurry-up house repair men.

RAILWAY TESTS SUPER-RAIL

In fifty years American railroad rails have gone from the one in the center to one at left and now the big one at right.

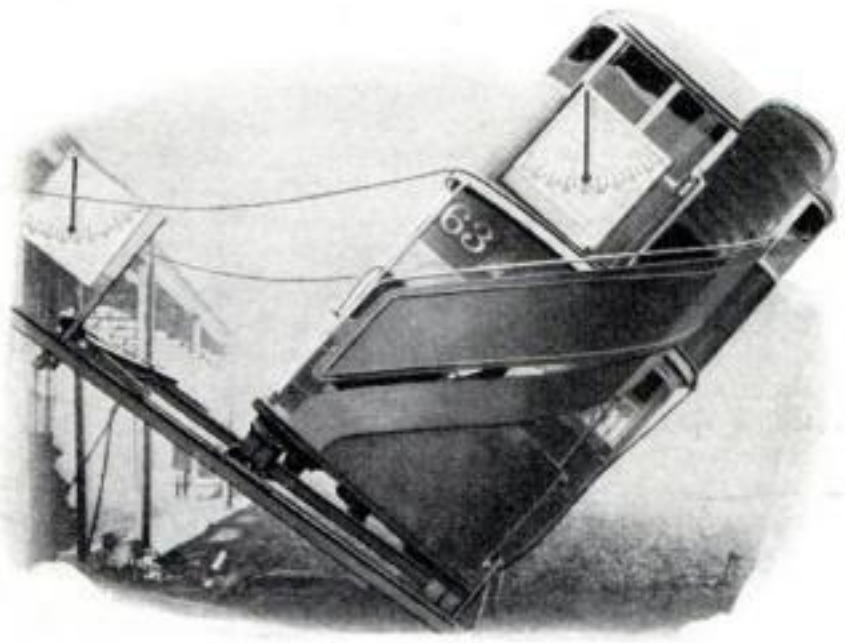
HEAVIEST used by any railroad in the world is a "super-rail" that was tested for service recently by the Pennsylvania Railroad. A yard of it weighs 152 pounds, or more than the average man. It will be about three-quarters again as strong as the rails now in general use, which weigh 130 pounds to the yard. In the picture it is compared with one of these and with a sixty-pound rail of fifty years ago, showing how rails are keeping pace with increased size of engines.

METEOR CUTS LIGHT WIRE

A METEOR'S prank recently plunged the town of Herman, Nebr., in darkness. The heavenly missile, falling during the night, clipped a main transmission line. Then it dug a fifteen-inch hole in the ground, where witnesses say it lay spouting flames for hours. Electric repair men hurried to the scene to splice the first recorded break made by a meteor. When the object was recovered, it was found to have been fused into a shape grotesquely resembling a small pig.

Meteors of this size seldom reach the earth, luckily for its inhabitants. But specimens of more than fifty tons have been recovered. An Oregon miner became the first person on record to run away with a big meteorite when he carted a fifteen-ton specimen from a field, whose owner sued successfully to get it back.

When this pig-shaped meteor fell at Herman, Nebr., it hit electric wire, cutting off light.



TILT LONDON BUSES TO PROVE THEM SAFE

OVER on its side until it seems as if it must fall, a double-deck bus tips upon a metal cradle in a London, England, testing ground. An engineer watches big dials that register the slant in degrees. He signals that it has passed its test for top-heaviness, and the bus is lowered to earth. Thus a London company makes sure its buses will not overturn easily when in a collision or on a curve.

RUSSIAN FIRE CHIEF IS STRIKING FIGURE

WHAT A Russian Soviet fire chief looks like when he goes into action is revealed in this unusual photograph. It was snapped in a railroad yard by a photographer who arrived on the scene just as the chief was signaling his men to bring up their apparatus.

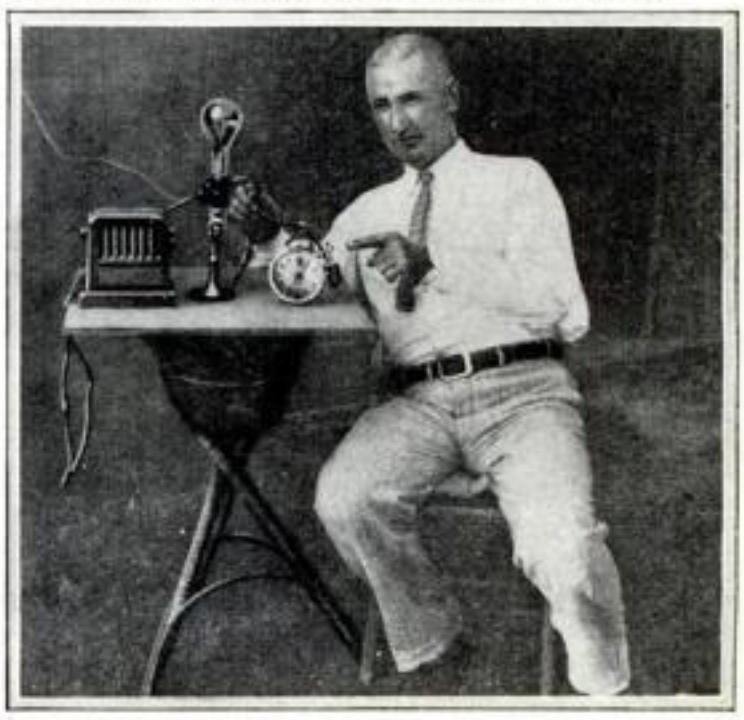
Ready for any emergency is this striking figure. as his costume indicates. An auto horn at his side and signal flags aid him to give orders to the brigade he commands. This is necessary because vocal instructions are out of the question for him. A gas mask covers his entire face to shield him from smoke and noxious fumes. His helmet carries a spike to ward off or break up falling fragments of masonry and glass that would cause injury if they landed solidly.

ALARM CLOCK COOKS HIS BREAKFAST

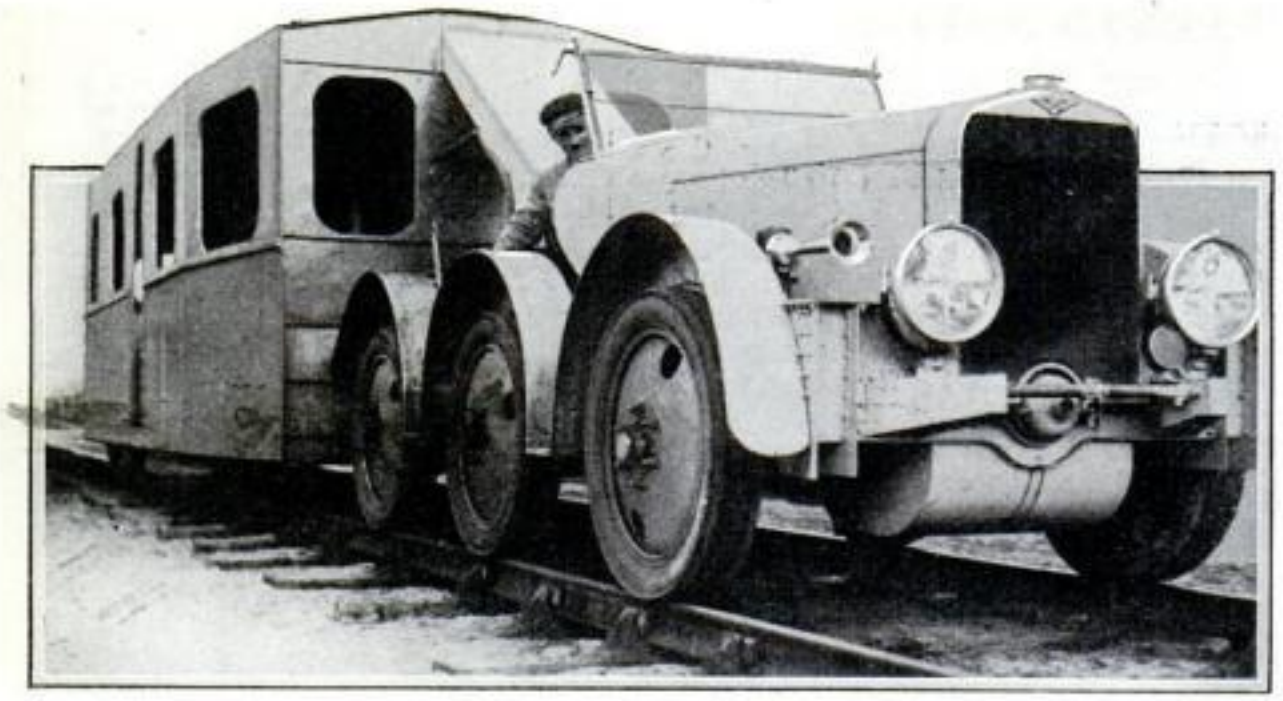
A SIMPLE attachment for any alarm clock converts it into an instrument that will start a stove or a radio by electricity at the same time that it wakens the sleeper. The inventor, Alfred C. Alves, of San Antonio, Texas, uses it to turn on a light and cook his morning toast.

The necessary apparatus consists of an electric switch in the form of a hollow cylinder fitted to the side of the clock. The uncoiling alarm spring closes two electric contacts, turning on the current. By using a multiple socket, not only can a light be turned on, but several different appliances may be started working at the same time.

In cold weather the device could be adapted to close the windows and turn on the heat.



A. C. Alves, San Antonio, Texas, exhibits attachment he has invented to make alarm clock cook breakfast.



RAILROAD CARS RUN ON RUBBER TIRES

ODDEST of railway conveyances is a "mechanical snail" recently tried out by a French railroad on a branch line between Issoudon and St. Florent. Like the shell carried on its back by that lowly animal, this queer vehicle supports the front end of a passenger car. Its six-wheeled automobile chassis, complete with headlights and horn, tows the unique contrivance along the tracks.

The rubber wheels, with which both the gasoline-driven car and the passenger carriage are equipped, are an innovation in railway use. They are expected to reduce the noise and shock of railroad travel and to make passengers more comfortable.

Especially in Europe, the need for economy in branch line traffic has led to strange vehicles. Faced with bus competition, an English line developed the "ro-railer" described in recent issues of this magazine, a novel type of auto bus that can travel either on roads or rails. In this country, Diesel-electric cars have been introduced in recent years wherever traffic does not warrant the running of full-sized trains. Each of these innovations shows the influence of the automobile and the competition that road motor vehicles have forced upon the railroads.

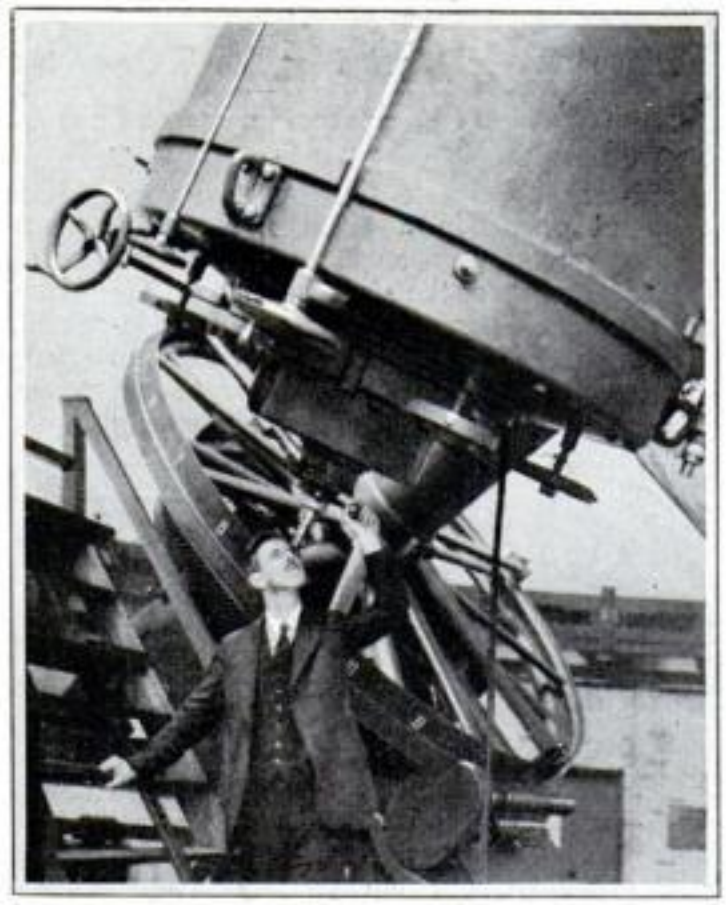
AMERICA'S GIANT TELESCOPE IN USE

THIS month the biggest telescope ever made in America will begin to reveal the wonders of the stars to students at Ohio Wesleyan University, at Delaware, Ohio.

Thus comes true the dream of the late Hiram Mills Perkins, for fifty years a member of the university's faculty. A few years ago he died a poor man because he had given virtually every cent of the $250,000 he amassed during a lifetime to purchase the telescope and an observatory to house it. Living on a modest scale and turning over to the university the profits of his judicious investments (he attempted to do it without making his name known), this one man has brought to a college of only 2,000 students an instrument whose power is surpassed by only two other telescopes in the world.

Moreover, its sixty-nine-inch mirror, which U. S. Bureau of Standards experts guarded watchfully as it cooled for eight months in the mold (P. S. M., May, '28, p. 48), is free from slight imperfections that mar the 100-inch telescope at Mount Wilson, Calif., and the seventy-two-inch reflector at Victoria, B. C., and is therefore expected to be practically as effective as the larger ones.

It is the first telescope of its size to be dedicated primarily for the use of a university's students.



At Ohio Wesleyan University, the biggest telescope ever built in America will be put in use this month.

HURT BY PERSEVERANCE

PERSEVERANCE is usually regarded as an admirable trait, but Dr. W. J. Pinard, English psychologist, finds it is often overdone. His experiments showed that many people stick to plans or projects long after hope of success has passed. By doing so they often become sensitive, rebellious, and nervous.

HEAT FROM SUN'S RAYS MAY DESTROY DIAMONDS

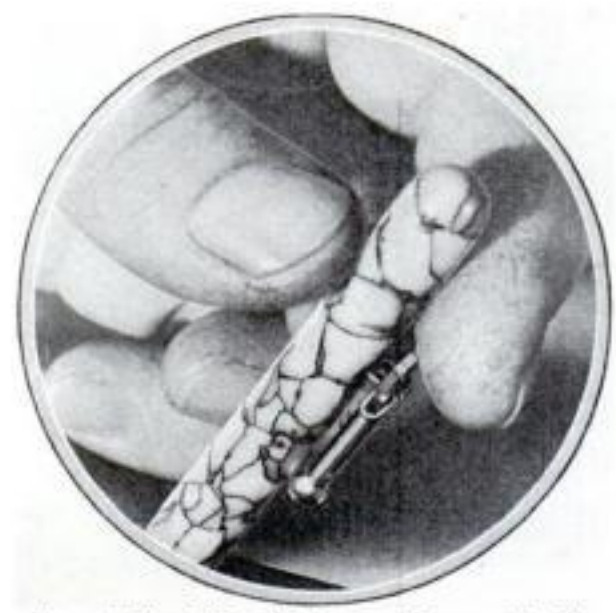
RESEMBLING a miniature astronomical telescope, the model shown below is a replica of a fifteen-foot-high "solar furnace" to be built at the California Institute of Technology, at Pasadena, Calif. It is expected that this powerful "burning glass" will be able to collect and concentrate enough of the sun's heat to destroy diamonds.

Nineteen lenses focus the sun's rays at one point, where it is hoped a temperature of 4,500 degrees centigrade will be maintained—a temperature about 1,000 degrees higher than that at which diamonds vanish in vapor. This heat, while intense, is still below the temperature of the surface of the sun, while its interior heat is confidently believed to be many thousands of degrees hotter. The heat of some of the more distant and larger stars reaches an incomprehensible figure.

Nineteen lenses catch the sun's rays in a solar furnace to be built after this model.

BARBED PENCIL CLIP CLINGS TO POCKET

VIRTUALLY impossible to lose is the pocket pencil equipped with a new clip. When it is slipped over the edge of the pocket, two little barbs catch in the cloth. The clip can be withdrawn when a spring at the top is pressed, releasing the barbs. The inventor got the idea when a fishhook was accidentally caught in his clothing.



Two fishhooklike barbs on this pencil clip prevent it from falling out of the pocket.

SUMMER HOTTER BUT SUN'S HEAT IS LESS

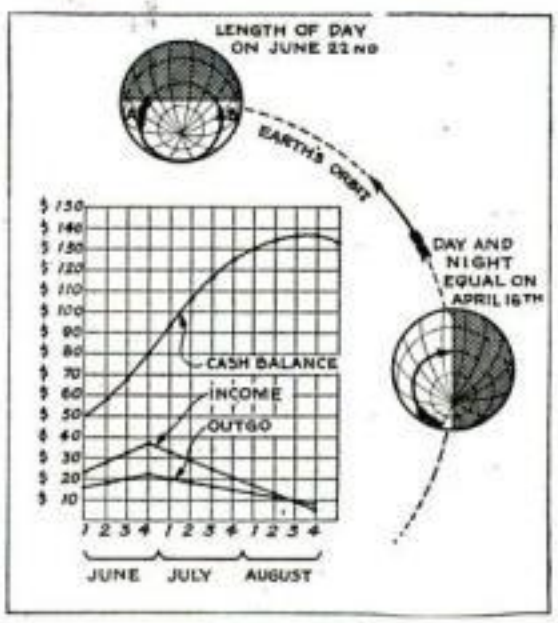


Diagram shows you why August is likely to be hotter than June, though the sun is then nearer to the horizon.

THE fact that spring and summer gradually grow warmer is caused by the increasing angle at which the sun's rays strike the earth's surface. As the world travels through the spring months, the changing position of its slanting axis (relative to the sun) tips the northern hemisphere toward the solar rays.

From this it seems natural to expect the hottest weather when the largest amount of heat is being received, toward the end of June. But August, as everyone knows, is apt to be our most torrid month. Why?

A moment's consideration of the diagram will give the answer. At the end of June the sun shines through a long day, from sunrise at *A* to sunset at *B*, yet the ground's stored-up heat is radiated into space only through the short night that lasts from *B* to *A*. Heat is received and absorbed for about eighteen hours.

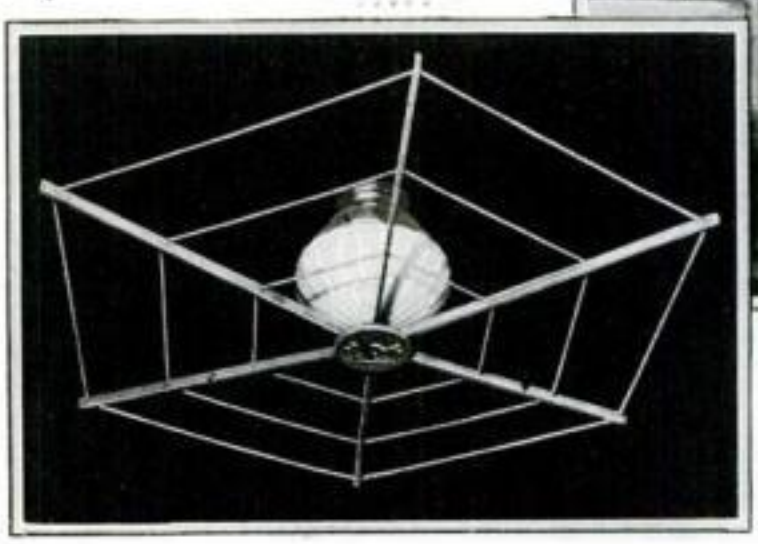
The result is a steadily increasing amount of heat in the ground, and consequent warmer and warmer days until the lessening angle of the solar rays combined with shorter days and longer nights bring cool autumn weather.

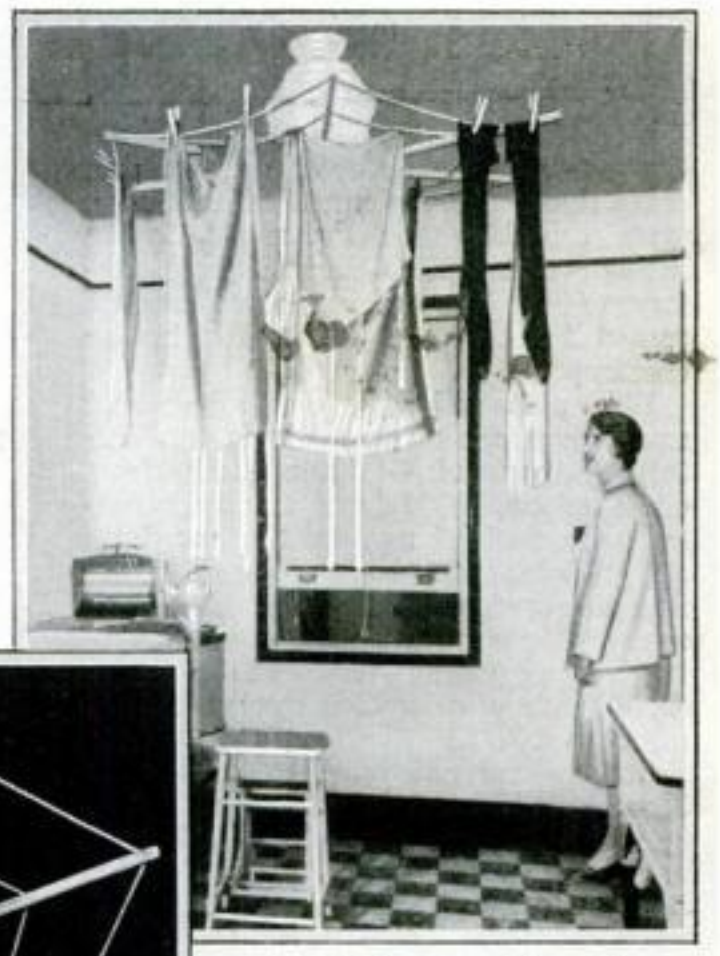
The process is well illustrated by a cash account. Suppose that a boy starts selling magazines through the summer with $50 in the bank. The first week in June he makes $24 and spends $16 for expenses. The second week he makes $28 and spends $18. The third and fourth he makes $32 and $36 and spends $20 and $22.

All through July and August he makes $4 less each week and spends $2 less, but in spite of this steady two months decrease of income after June, the boy's bank account reaches its maximum of $136 in the second week of August, just when the world's "heat account" also shows its maximum deposit.

MECHANICAL RACK WHIRLS CLOTHES DRY

AROUND and around spins the housewife's wash, on a whirling frame attached to a ceiling lamp—and in a few minutes it is dry. The bottom of this novel combination fixture, which has been recently placed on the market, contains an electric motor. A snap of a switch, and the frame begins to revolve. If anyone puts his hand in the way of the whirling frame, no harm is done; as a finger's pressure is sufficient to stop it. When not in use the frame, which is detachable, folds up like an umbrella, and it may be conveniently stored in a closet. The control switch may be placed at any point on the wall of the room.





Clothes hung on this mechanical rack, which is built into the base of a special ceiling lamp, are quickly whirled dry. The device is so built as to avoid any danger of tearing the clothes or hurting anyone.

NEW FOUNTAIN PEN FILLED BY WINDING

A NEW fountain pen is filled by turning the end of its barrel while the pen point is immersed in ink. It was recently put on the market by a Toledo, Ohio, manufacturing firm. Turning its barrel in the opposite direction empties it. This device works without the aid of a rubber sack.

GEESE CHANGE ROUTE

MILLIONS of wild geese have changed the course of their flights above North America because of the handiwork of one man. Jack Miner, Kingsville, Ontario, has constructed a bird sanctuary there that attracts almost all the wild geese of this continent on their seasonal flights between the north and the south.

SIGNPOST AIMS PIPE AT MT. WHITNEY

"WHICH is Mt. Whitney?" This was a question frequently asked by visitors to Lone Pine, Calif., before an odd signpost pointed out the famous peak. A notice board and arrow indicate the general direction of Mt. Whitney. Farther down a piece of pipe is attached. Looking through this, visitors are left in no doubt as to the famous peak's identity, as they can easily distinguish it from other peaks of the Sierra Nevada range. Mt. Whitney, 14,496 feet high, is the loftiest in United States.

A piece of pipe attached to this signpost is aimed at Mt. Whitney to help tourists find it.

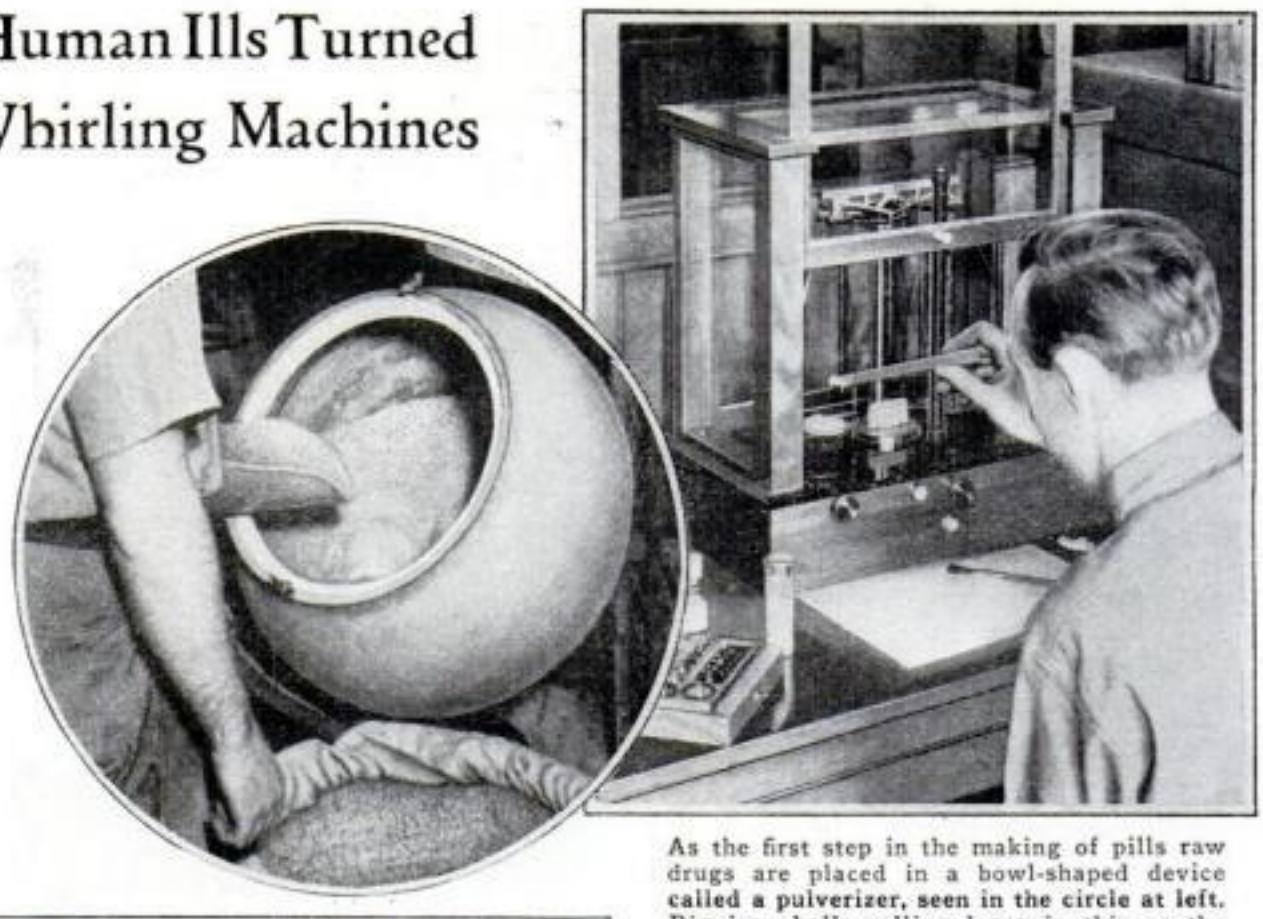
Thousands of Pills for Human Ills Turned Out Each Minute by Whirling Machines

WHERE do the pills that you take for a headache or a stomach pain come from? The pictures on this page, made especially for POPULAR SCIENCE MONTHLY in a New York City pill factory, tell the story of how raw drugs are turned into finished pellets for human consumption.

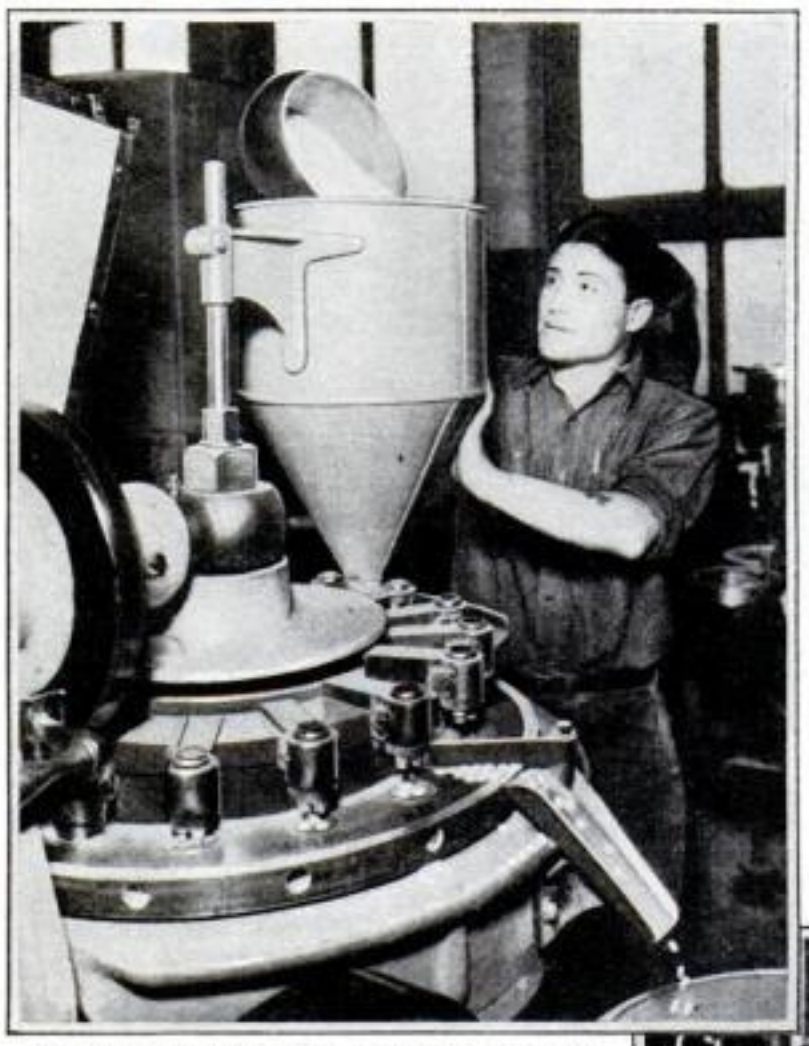
Blue pills and pink ones, large and small, pour out of machines in this factory by thousands—1,300 a minute from one machine, 3,000 from another. Batteries of mechanisms seize the raw drugs and reduce them to a powder before stamping and molding them. All processes in their manufacture, except weighing and portioning the ingredients for each batch of pills, are carried out by machinery.

Strange and unfamiliar to the layman are the names on labels attached to bags, boxes, and jars of raw drugs in this firm's storeroom. Most of them are long Latin "jawbreakers" that only druggists could understand. Among them, however, are some old friends, such as chestnut leaves, marigold, poison ivy, and bees' stingers, which go into special pills for calming the nerves. They are picked by hand from dead bees. A good bee-stinger picker can collect as many as 500 a day.

Two separate types of pills are made, allopathic and homeopathic. The first are stamped out under pressure and are hard and firm. Homeopathic pills are molded, resulting in a pellet that can easily be crushed to a powder between the fingers.



As the first step in the making of pills raw drugs are placed in a bowl-shaped device **called a pulverizer, seen in the circle at left.** Big iron balls rolling loose in this as the bowl spins reduce the drug, here dried marigold flowers, to a fine powder. The next step, shown above, is to measure out the amount of each ingredient with the utmost care. The picture shows a skilled worker weighing out a minute quantity of strychnine on a balance so delicate that a grain of dust moves it.



After drying in an oven, the powder goes into this machine out of which pills come ready for the bottle at the rate of 1,300 a minute.

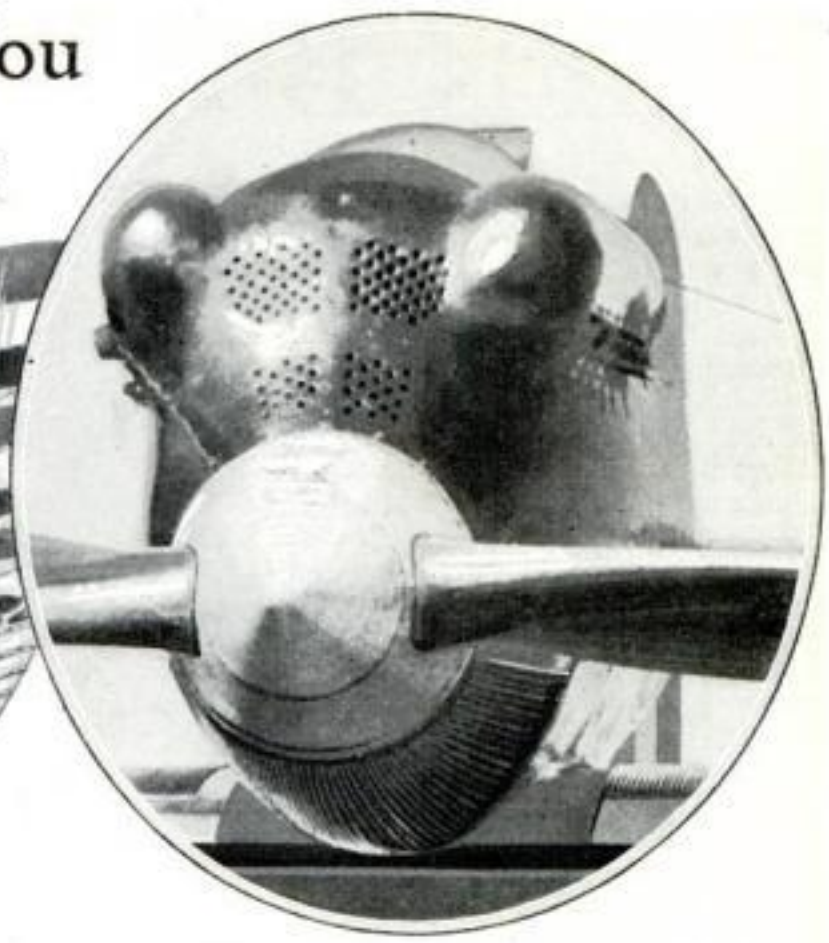
Into the labeling machine then go the filled bottles and when they come out, each bears a neatly printed label all ready for the drug store counter.

When this cover is lowered, loose pills are dumped on top of it **and the cover is then agitated until the pills have all fallen through the little holes into the bottles. When the cover is lifted, as seen above, all of the bottles are full of pills.**

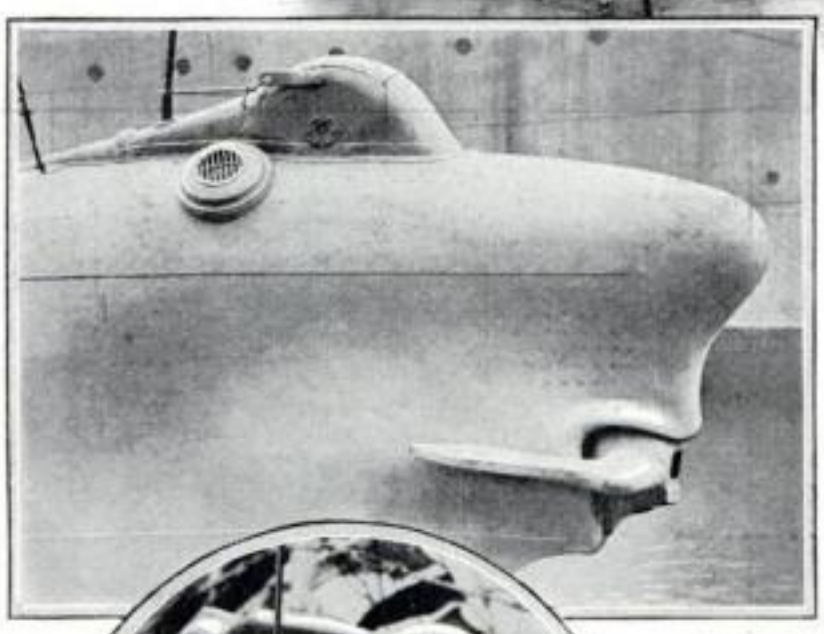
Pill makers take no chances, and in this laboratory each batch of pills is tested. In the glass vessels the chemist can see what happens in the stomach when pills are taken.

Strange Faces of Monsters You Can See on Water or in Air

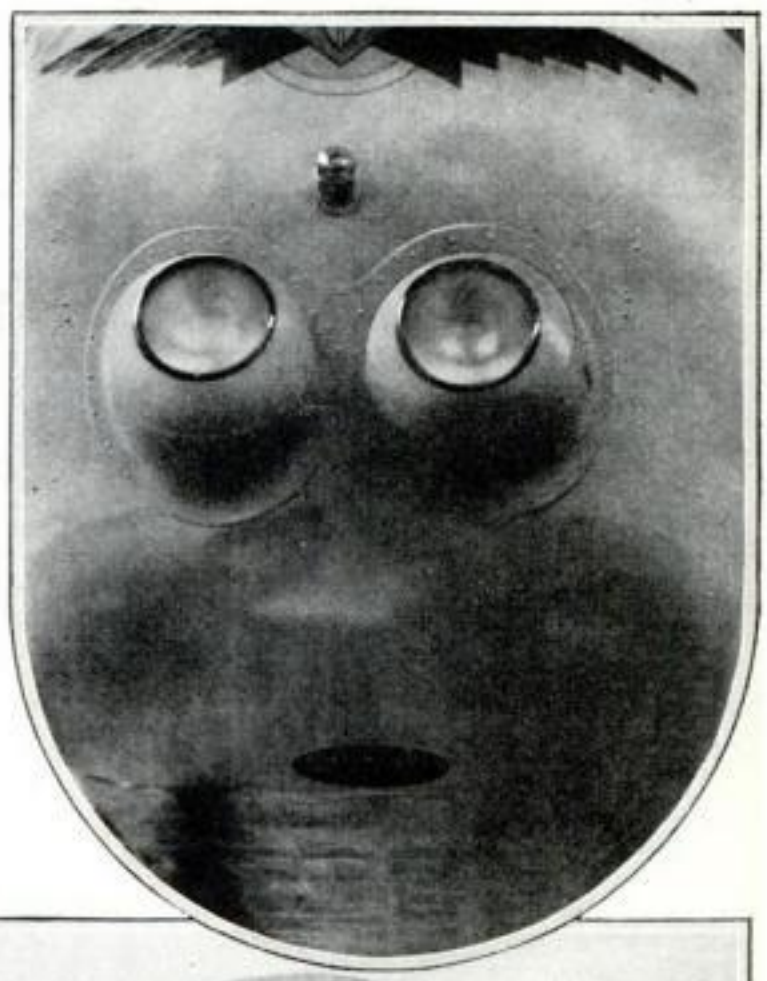
SMALL-FACED MONSTER. The tiny pinched-up face on this colossus is merely a view of the plane carrier *Lexington*.

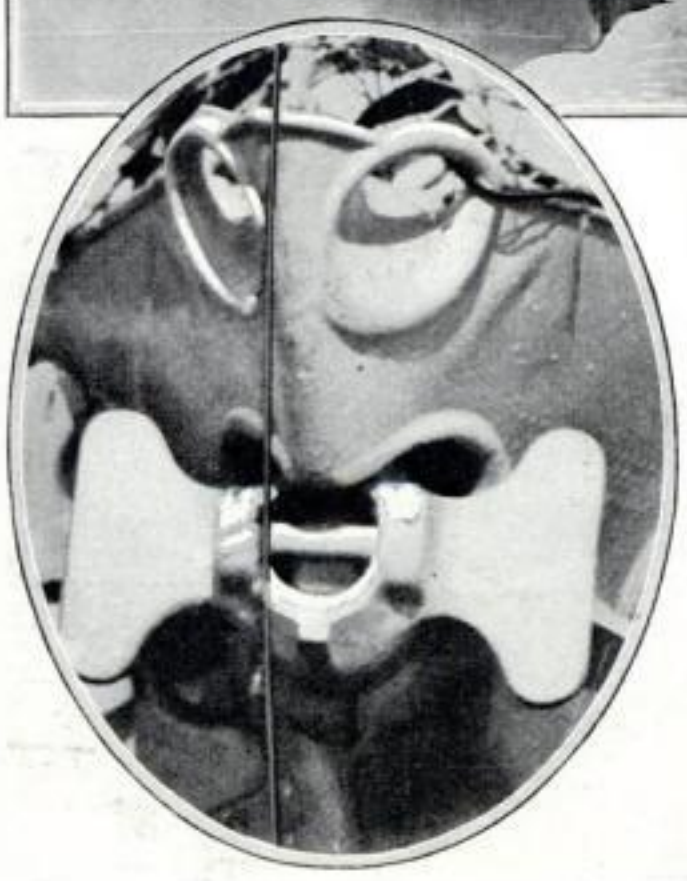


HARD EYES OF A BEETLE. This nightmare bug, looking like a thing of horror dropped out of space, is a rare photo of the speediest plane motor, Schneider cup winner.

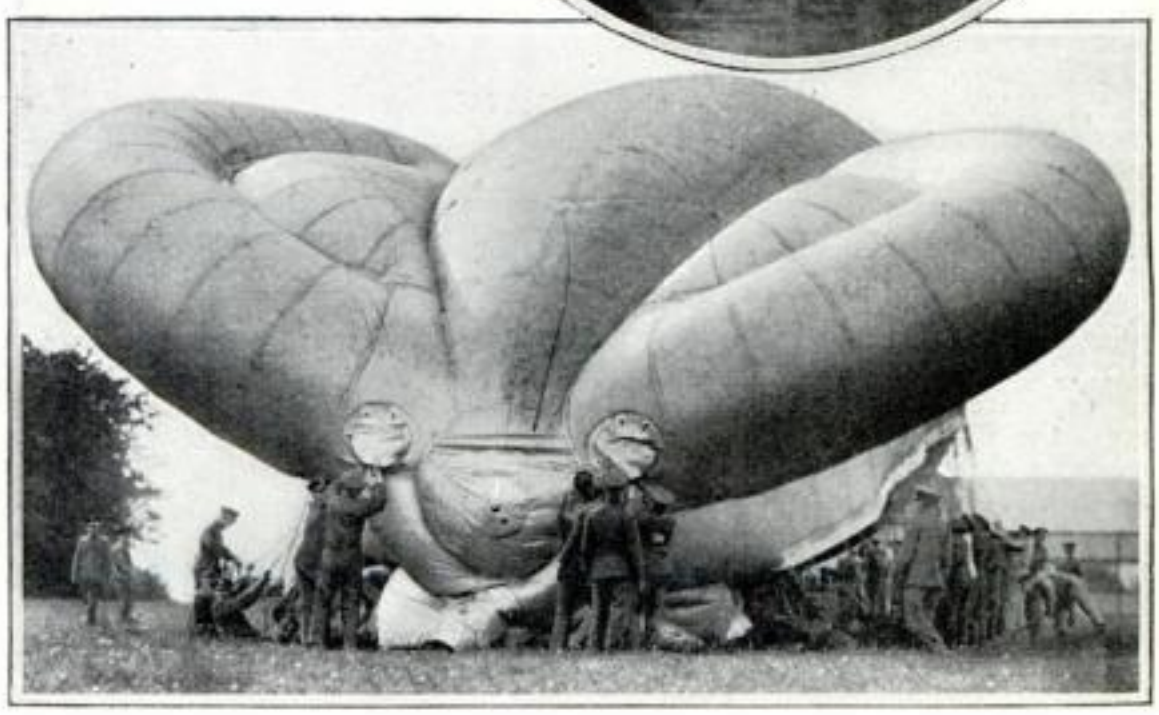


TELESCOPE EYES. At right, this face, looking like that of a deep-sea creature, is a startling view of the front of a Farman type passenger carrying airplane.





WHALE OR SHARK? It is neither, but it certainly looks like a fish. It is a kind of fish—the stern of a U. S. submarine.



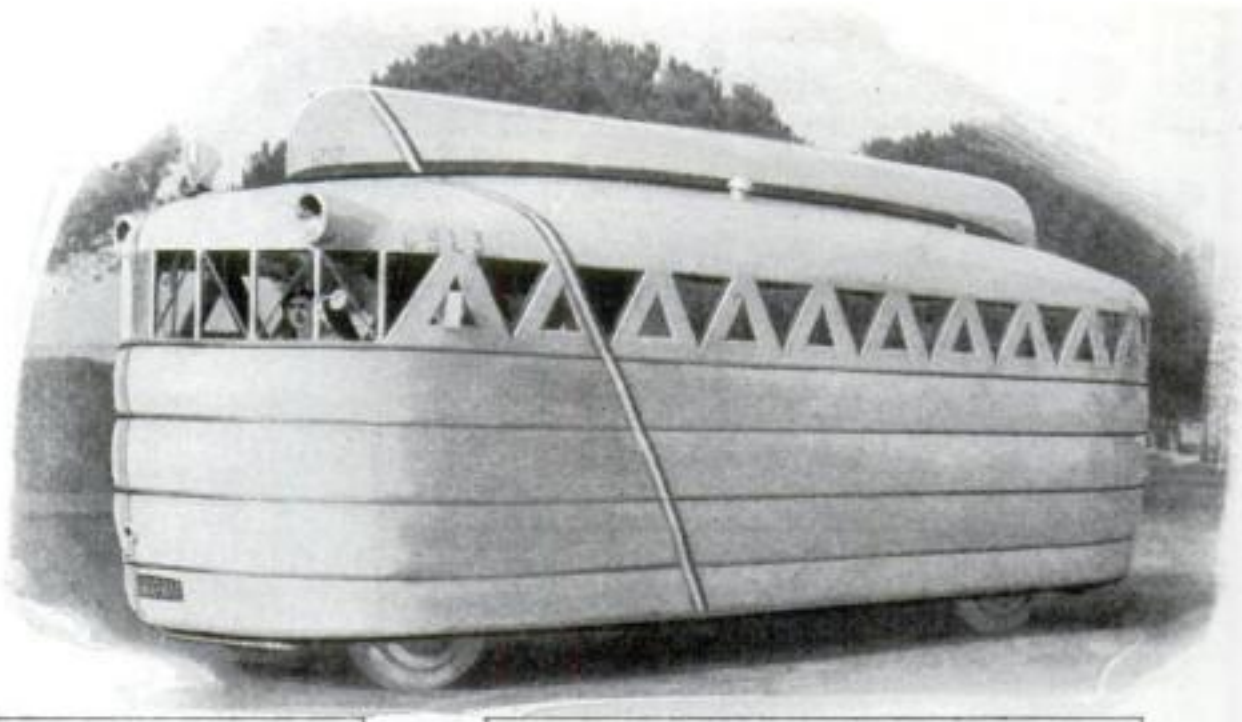
SHOWING HIS TEETH. You'd never guess that this is the bow of the U. S. S. *California* showing its face to the enemy. At right, the gigantic insect is in reality one of England's great observation balloons.

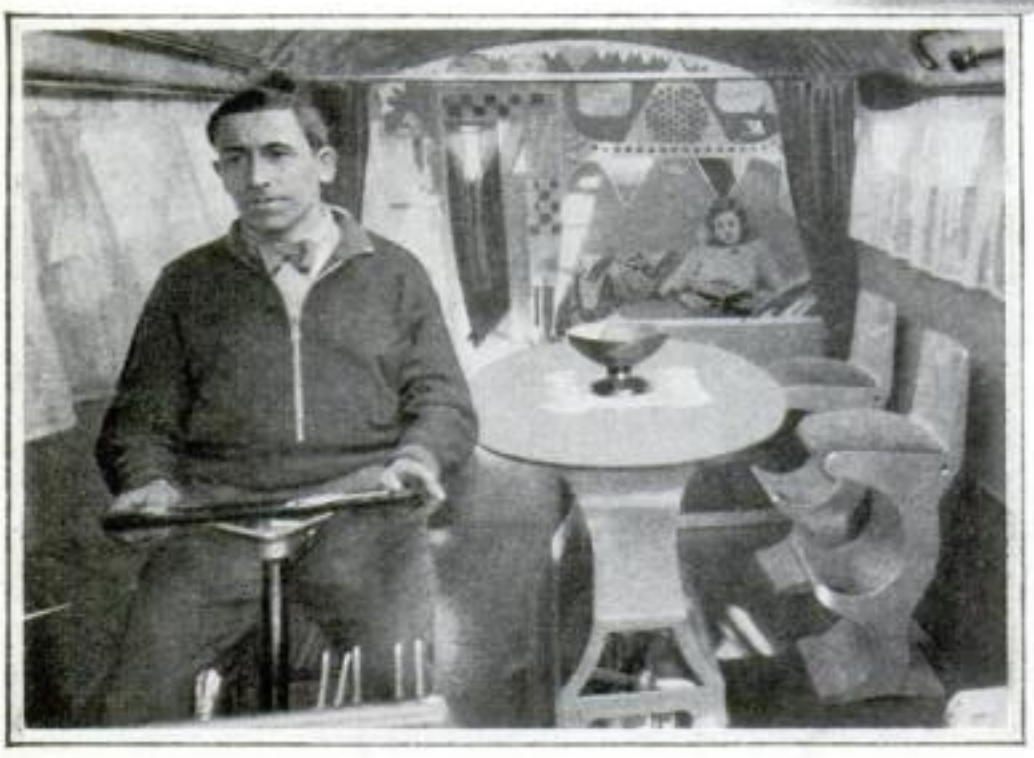
Builds Bus for Summer Home

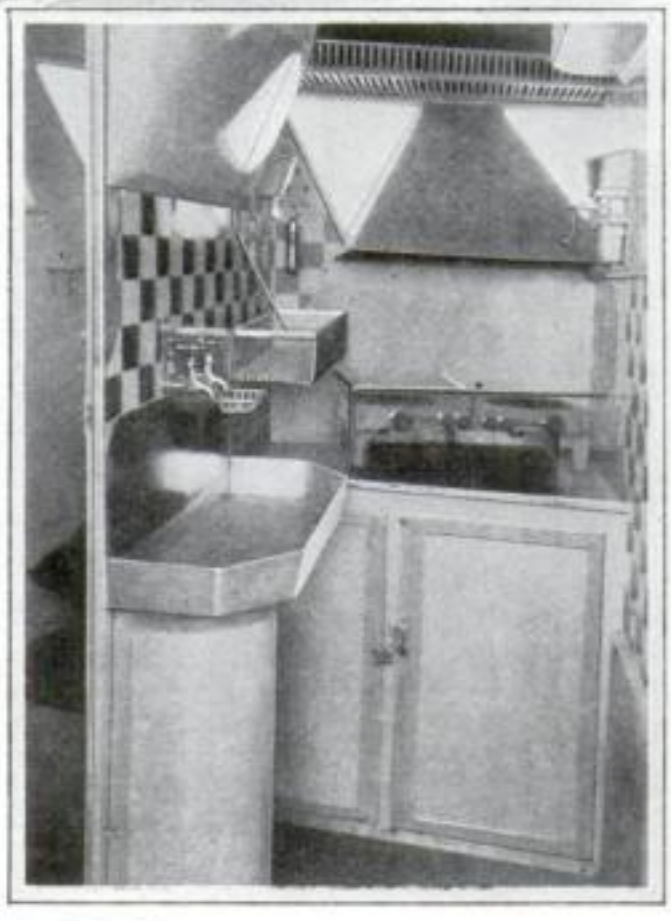
LIKE an armored tank in outward appearance, one of the strangest of auto buses was built by a French engineer. This veritable house on wheels takes him and his family on pleasure trips of any duration.

The driver sits in the living room, as seen in the photograph directly below. The motor is beneath the living room table. This arrangement provides spacious living quarters. At the rear is a bedroom with comfortable sleeping accommodations. Kitchen and lavatory occupy individual compartments.

When a canoe carried on the roof is removed, sunlight streams in through a latticed window in the ceiling. All the necessities of a hunting trip—guns, fishing tackle, and other sporting paraphernalia—are carried in racks on the walls. The twenty-three-foot car is a good hill climber, weighing only 3,500 pounds.







At upper right, the strange "armored car" is merely a large-bodied pleasure machine built for a French engineer and his family and which provides them with a real house on wheels. Above is a view of the large living room in the giant auto, and at the right the kitchen in which elaborate meals can be cooked. The car's engine is installed beneath the table in the living room.

AUTO IS MOTORBOAT WHEN ON PONTOONS

AN AUTOMOBILE was turned into a motorboat recently by two Texas fishermen as an aid in reaching their fishing camp. This odd craft consists of two pontoons tied together in a parallel position by bracing. It is fitted with propeller and rudder. When a car is driven onto it, the rear wheels rest between two friction rollers on each pontoon.

The car is locked in place with chain bolts, the ferry is shoved off, and the auto started up, just as if it were being driven on dry land. Its rotating rear wheels cause the propeller to turn, driving the pontoons ahead at a smart pace. Since its steering gear is connected to the ferry's rudder, the steering wheel functions just as it would on a land road. There is no relation, however, between the speed shown on the auto's speedometer and the actual rate at which the improvised ferryboat is passing through the water.

Texas fishermen have turned their auto into a veritable motorboat by running it onto pontoons fastened together. The rear wheels furnish the power to turn the propellers and drive the craft through the water, guided by the rudder which is hooked to steering wheel.

RADIO WAVES BARRED FROM THIS ROOM

Protected by one mesh of galvanized wire and another of copper, this experimental room bars radio waves.

THE most sensitive radio set in the world could not pick up a single station from within a room at the Westinghouse Research Laboratories in East Pittsburgh, Pa. It is a large cage of metal screening inside which an engineer measures the sensitivity of experimental radio tubes and circuits. Even the electrical "click" made by the snapping of an ordinary electric light switch would interfere with this work.

It has double walls. The outer one is a fine mesh screen of galvanized iron wire, and the inner one of copper wire. There is but one point of contact between the double walls. Even electricity for lighting this strange room is passed through special filters so that it will not disturb the delicate experiments carried on within it.

AMERICAN FIRMS ADOPT THIRTEEN-MONTH YEAR

WITHOUT waiting for the proposed revision of the thirteen-month year scheme by the League of Nations in October, 115 American business firms have now adopted the new calendar.

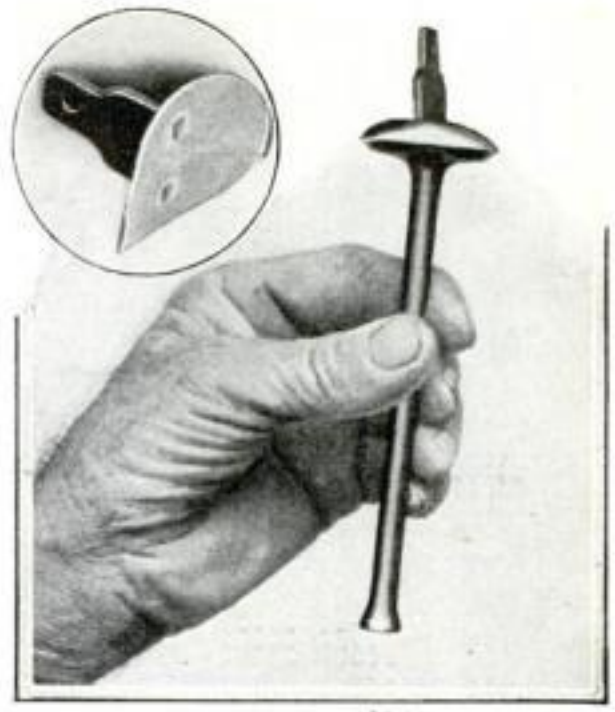
In 1927 the League of Nations suggested that the present calendar, with its unequal lengths of months, was not suited to modern business conditions. It proposed a new year of thirteen months of twenty-eight days each. Such a calendar would leave one day in each year that did not belong to any month. This day is to be set aside as an international holiday.

RED FLARES DESIGNED TO GUARD MOTORISTS

ESPECIALLY designed for motorists is a new type of signal fusee resembling the red danger lights that railroad men use. Should a motorist find it necessary to change a tire on the road at night, he takes two of the fusees from his tool box and places them ahead and to the rear of the machine. Their brilliant red glare is an unmistakable warning to approaching cars that someone is working on a machine at the roadside. In addition to protecting the working motorist, they furnish illumination for his labors.

Each fusee will burn for ten minutes, giving off ample light for ordinary roadside work like changing tires. The fusees when lighted can be stuck into the ground, into joints between concrete slabs of which the road is formed, or into fences or posts at the roadside.

Red flares, burning rear and front, guard motorists while making repairs. Flare shown in circle.

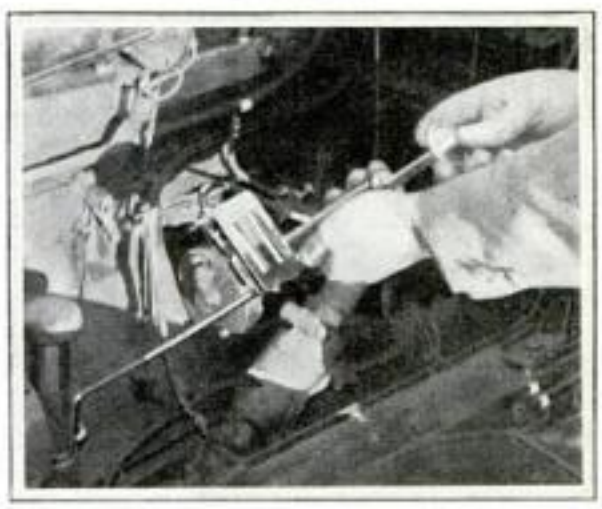


NEW TOOL SPEEDS UP GRINDING OF VALVES

IN AN effort to eliminate warping of valve heads, many automobile manufacturers are using valves in which neither slots nor holes for grinding tools are provided. Grinders with rubber suction cups handle new and smooth valves of this type, but do not grip so well on pitted and burned heads.

An improved grinder now on the market is positive in action. It is a simple device made up of a thin, convex disk of spring steel having two shallow lugs, and a stem for attaching to any commercial grinding tool. Pressure on the disk snaps the lugs over the edges of the valve head, where they grip sufficiently to rotate the valve against the friction of the cutting compound. As they do not extend below the top of the bevel, they do not interfere in any way.

Valves having upset ends can be ground with this tool merely by removing the spring cotter, which permits of the head being raised more than an inch.



SUCTION TESTER SHOWS STATE OF CAR'S OIL

WHETHER the oil in your car's crank case needs changing is easy to determine with the aid of a handy portable tester. One stroke of its suction-pump handle draws a sample of the oil from the crank case into an illuminated glass vessel. Even an inexperienced eye can compare its color with a sample of new oil, and with a piece of glass colored to represent oil just going bad, beside it in the instrument. Blackening oil indicates the presence of dust, metal particles, and carbon, making the lubricant unfit for use.

HOLSTER FOR GUN HOOKS TO CAR'S GEAR SHIFT

DESIGNED as an aid in foiling holdups, a pistol holster, the product of a New York City manufacturing firm, holds a revolver on the gear shift lever of an auto. Steel clips secure it to the lever. On electric trucks, which have no shift lever, the holster is fixed to the steering column just below the wheel.

Bank employees can use this device on their desks. A small standard to which a short vertical rod is attached is used then. The holster clips to this as it does to the shifting lever on an automobile.

WATCHES USED AS CAR'S HUB CAPS TO TEST THEM

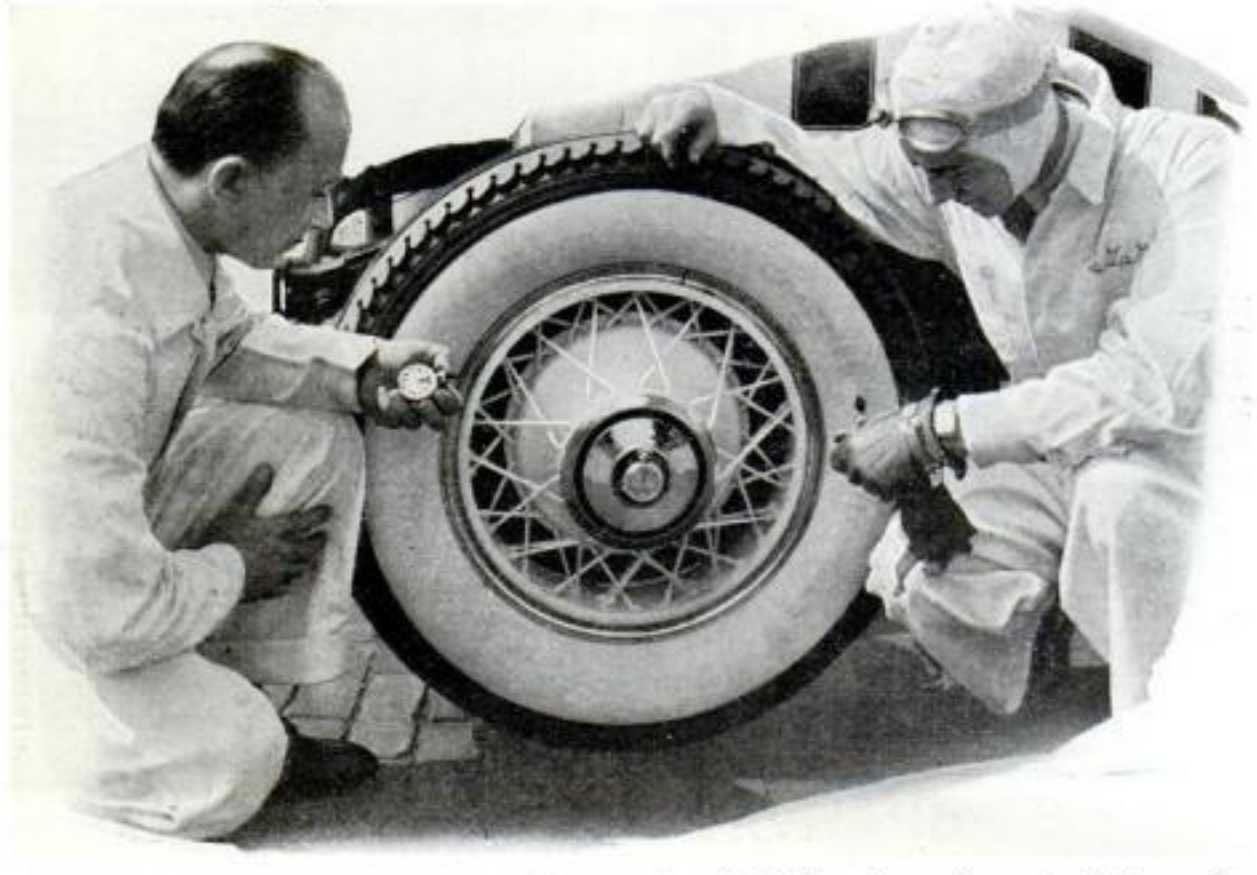
FOUR watches were used as hub caps on a racing automobile in a test made at the Speedway oval in Indianapolis for a manufacturer of timepieces. The test was made to determine the effect on the watches of the vibration due to high speed.

Examination at the end of the test showed that three of the four watches had kept perfect time, and the fourth lacked about five tenths of one percent of attaining a perfect record. This is well within the requirements of the Bureau of Standards for that type of watch under normal conditions of everyday use.

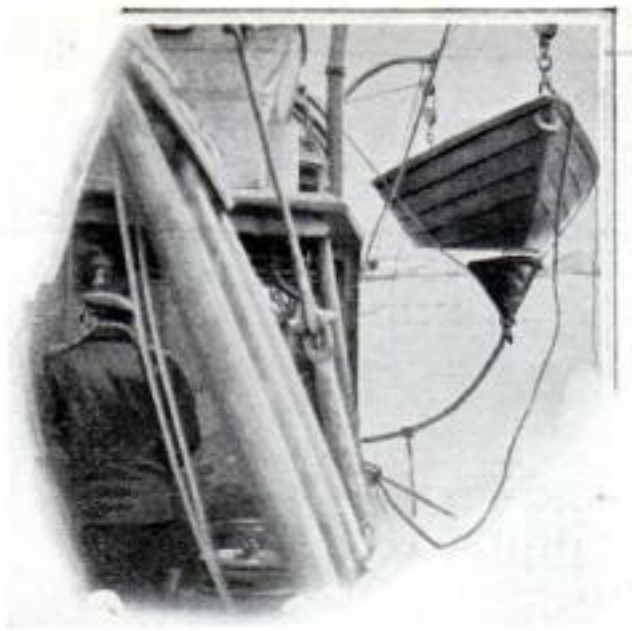
180-FOOT ROPE ELEVATOR RAISES MONKS' VISITOR

A CREAKING hand windlass is the motive power of an elevator that carries visitors to a monastery in the eastern part of Greece. Perched on an airy pinnacle of rock overlooking the plains of Thessaly, the Holy Trinity Monastery can only be reached by this crude rope elevator. Its car is a rough net in which a visitor is tied up in uncomfortable fashion. On a signal to the "elevator operators" on the cliff above, the visitor is slowly drawn up. The pillarlike spire of rock on which the monastery stands is 180 feet high.

In this primitive basket of ropes visitors to a monastery in Greece are hoisted 180 feet.



With watches as hub caps this car was driven at a hundred-mile-an-hour clip on the Indianapolis racing oval and afterwards it was found that three of the watches had kept perfect time.



SHIP GETS WATER WITH FUNNEL AND HOSE

THE other day officers of a ship in the Bering Sea put their small boats to a novel use in replenishing their water supply, which had begun to run low. Putting in at an island of the Aleutian group, they filled extra boats they had brought along with fresh water from a snow-fed stream. These were towed back to the ship. The sea luckily was calm, so none of the precious cargo was spilled.

When they got alongside they discovered there was no pump on board that would raise the water from the boats to the ship's tanks. They solved the problem of getting the water aboard by hoisting the boats on the davits. An improvised funnel of sail cloth, connected to the ship's tanks by a hose, was secured under the drain plug in each boat's bottom. When the plug was drawn out, the water ran by gravity into the tanks.

LIGHTED MAP HOLDER DESIGNED FOR AUTO

AN ILLUMINATED map holder is a convenience for motorists recently developed by a Cresco, Iowa, manufacturing firm. A board to which a map is secured is attached to the steering column of a car a few inches below its steering wheel. Thus the driver can conveniently see it at all times while driving, and it does not interfere with his operation of the car. The device should also be handy for holding lists of addresses for salesmen and others.

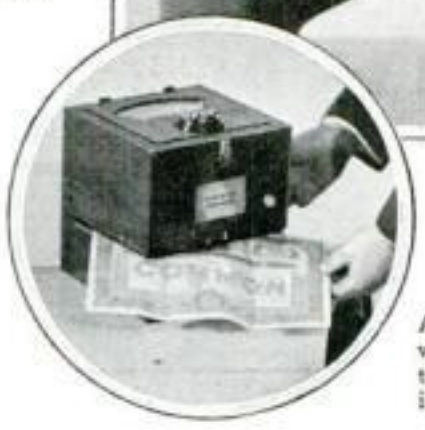
At the left side of the map board is a small electric light and switch. If the driver wishes to consult his map at night he has but to snap on the switch and the map is lighted up. The light is hooded so it does not shine in his eyes or interfere with his vision while driving.

NEW METER GAGES PAPER'S THICKNESS

BY FURNISHING paper that was too thick, a waste of material, or too thin, causing dissatisfied customers, paper companies were losing thousands of dollars a year not long ago. Westinghouse engineers tackled the problem and recently perfected a novel meter that instantly registers the transparency of paper. An electric eye measures the opaqueness of a sheet to a beam of light. With its aid printers can obtain paper just thick enough to prevent printing from showing through on the other side. Other uses were quickly discovered for it.

Doubtful stock certificates are checked against genuine ones with the instrument's aid. Imitations are usually printed on thicker or thinner paper than real ones and are quickly exposed.

The sheerness of a silk stocking is measured with great accuracy by the new meter. It also shows whether a piece of costly tapestry, supposed to have been woven by a famous artist, is the same thickness as a piece of known authenticity.



This meter, designed originally to measure the transparency of paper, is here being used to find how sheer silk stockings are.

At the left, the meter is at work checking a stock certificate to determine if it is genuine or a counterfeit.

BANK MAKES PHOTO OF ALL CHECKS CASHED

WHEN a housewife loses the canceled check that shows she has paid her grocery bill, and the grocer insists she hasn't paid it, she needn't worry under a new scheme of check photography recently instituted by a large bank with offices throughout the country. She has merely to take her supposed creditor to the bank, where a photograph of the canceled check will be flashed on a screen at her request. The photograph is acceptable legal evidence that the bill is paid.

Every check drawn by one of the bank's depositors is photographed upon a strip of motion picture film when it returns through the regular collection channels, with a machine invented by a New York banker and perfected by the Eastman Kodak Company. The device ends disputes over unpaid bills and guards against forgery.

With the machine below all checks that come into a New York bank are photographed.

HIGH SPEED CLOGS ROADS

A ROAD reaches maximum capacity when autos travel at twenty-three and a half miles an hour, recent studies show. At this rate 2,600 cars pass a given point in an hour. At forty-five-mile speed, only 1,760 cars can pass, because they must keep farther apart for safety, as at such relatively high speed the minimum stopping distance is greatly increased.

ELECTRIC FLY SCREEN STOPS THE PESTS

A LUNCH room proprietor in Chicago, Ill., recently fitted an electrified window screen in his place of business to keep flies out. Current from the house lighting circuit is passed through the wire meshes so that flies, attempting to crawl through, are electrocuted. Another screen protects people from coming in contact with it. Similar screens can be applied to doors.

PINE TREES UPROOTED BY BIG TRACTORS

INDIANS of the Warm Springs Reservation, in Oregon, recently cleared a path for a road through a forested part of their reservation by using a tractor to pull up trees by the roots. The powerful machine was backed up close to a tree and hitched to it by a short cable. Then the tractor was started up and the tree pulled over, the tractor driver ducking quickly out of the way to escape being struck.

Photo Courtesy of American Lumberman

Indians used this tractor to pull up big trees in building a road.

Exposition for Inventors Attracts 3,000 Designs

A FIELD day for inventors was the International Patent Exposition at Chicago a few weeks ago. Hopeful designers of more than 3,000 devices showed off models of their inventions. Meanwhile, prospective buyers of patents strolled through the rows of exhibits. On this page are shown some of the novelties of the show. Evidently the scheme to bring inventors and buyers together was successful, for another inventor's exposition is planned for September.

At the Chicago patent show model cars were exhibited in a model of an improved automatic method for the mechanical parking of autos.

This artistic looking device is a new type life preserver intended to save the skater who crashes through thin ice.

Connected to the steering wheel of your car, this device automatically signals to the driver behind the turn you intend making, without the trouble of reaching for a button.

At left is something new in the shape of a putter for the ambitious golfer. The head is shaped like a shoemaker's hammer and is expected to send ball straight to the hole.

Housed in a spring reel, the cord of your electric iron can't get in your way, as shown in picture above. The device also has iron rest.

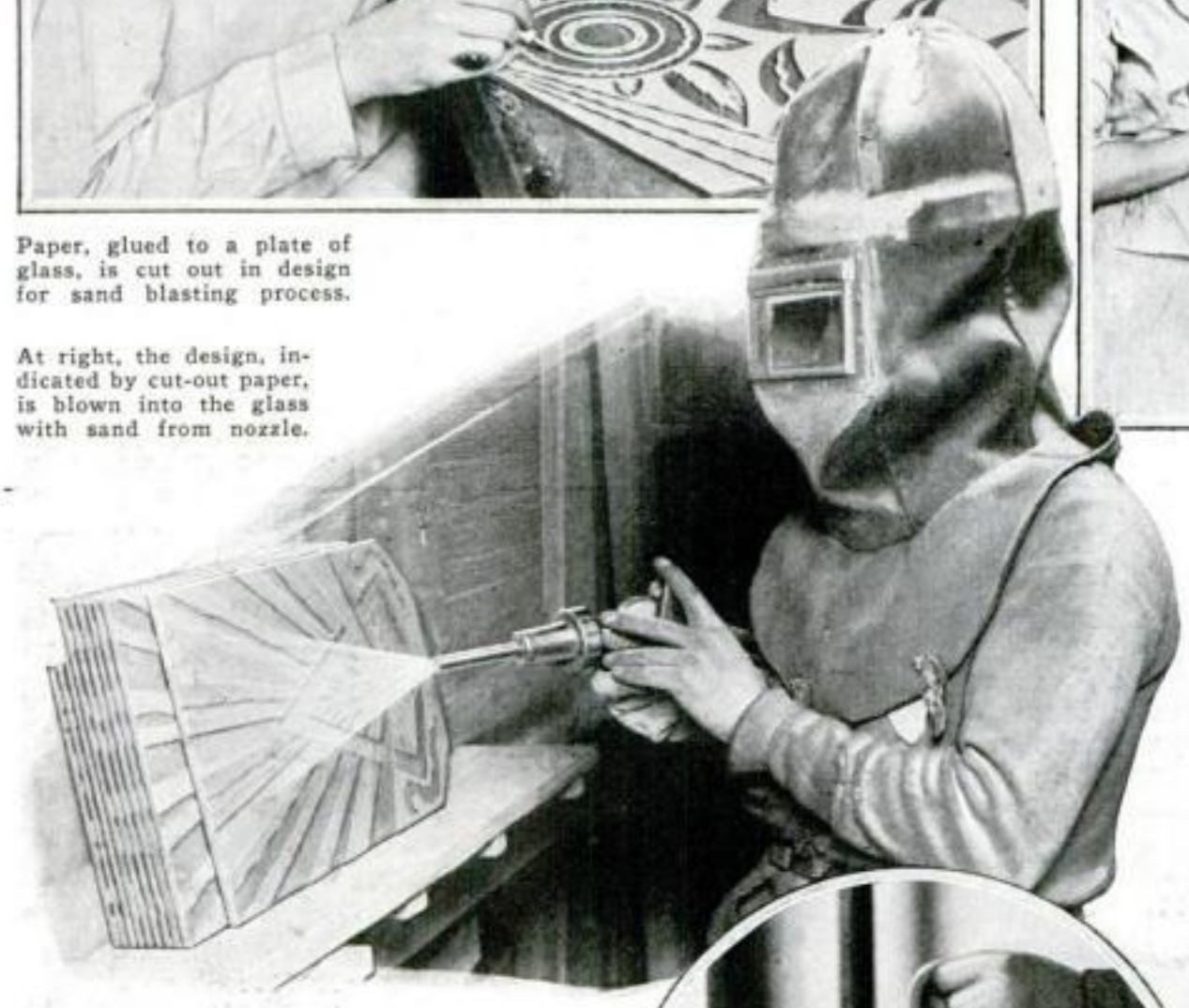
Hold-up men who tell you to "stick 'em up" will be out of luck if you are wearing one of the pistols shown at left. As arms are raised, a strap pulls trigger discharging gun.

Secret Glue and Sand Blast Etch Glass and Stone

Paper, glued to a plate of glass, is cut out in design for sand blasting process.

At right, the design, indicated by cut-out paper, is blown into the glass with sand from nozzle.

Here is the finished plate glass with the design sand-blasted upon it. With the new method etching takes only a few minutes.



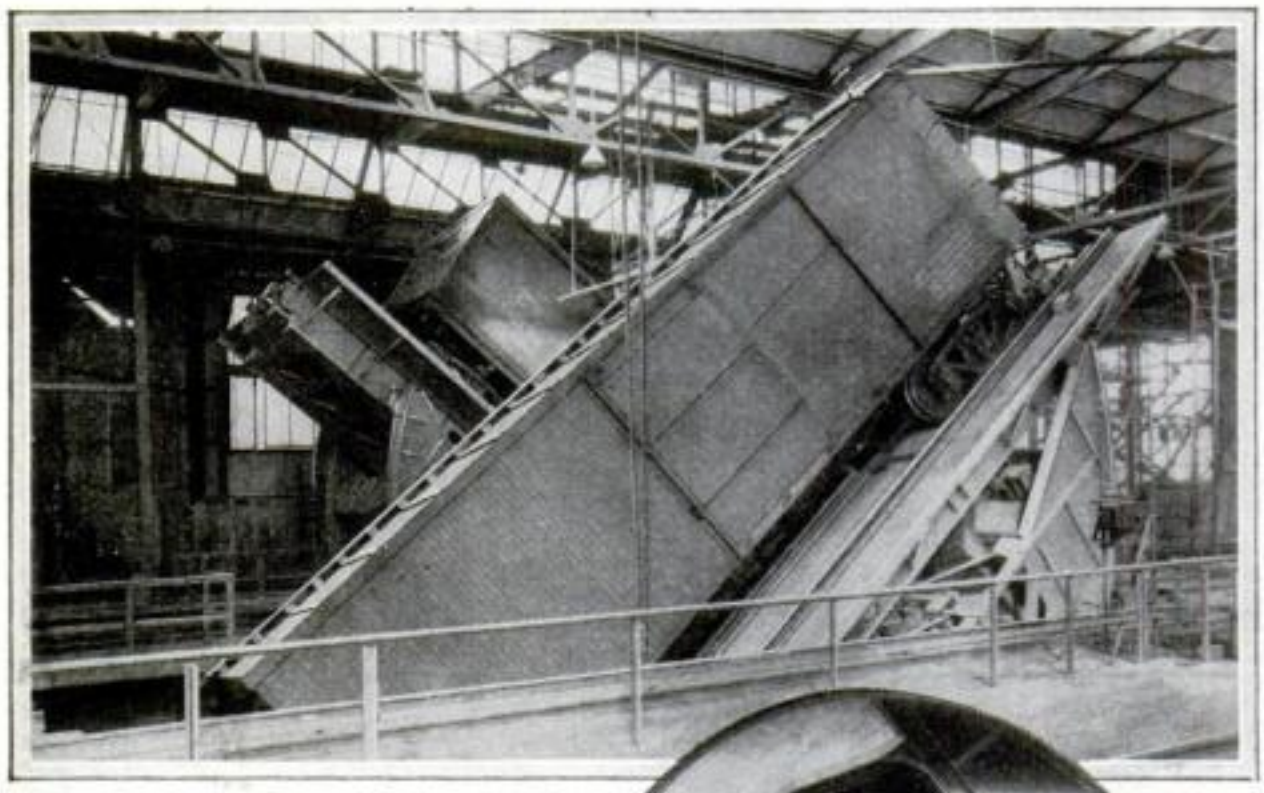
NOW the sand blast, familiar as the tool of men who clean the faces of buildings, has been put to work for art. As part of a process recently developed, it carves delicate designs on glass or stone, as shown in the pictures on this page.

For glass carving, the artist attaches a heavy piece of glued paper to the glass and cuts a stenciled design from it. Then a blast of air driven sand eats out exposed portions in the shape of the design.

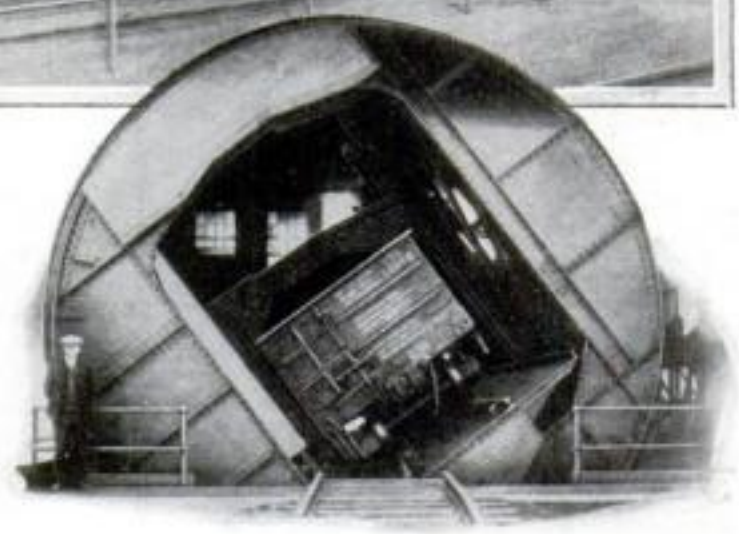
In a new process for carving granite developed by a Vermont inventor, the block is given a quarter-inch coat of a secret glue and the design is then cut in the glue. Sand-blasting bores out the design.

In the circle, secret glue is being poured upon the surface of a block of granite. At left, strips of glue are removed leaving the desired artistic effect, with the rest of the stone still covered with the thick glue. Above, the sand blast nozzle and the stone in which the design is blasted. The air driven sand eats away the exposed portions but bounces off the rubber-like glue. At extreme left, a panel of stone bearing finished design.

UNLOADER TURNS BIG CAR UPSIDE DOWN



Photos Courtesy Link-Belt Co.



Above, a modern unloader seizes a flat car and turns it upside down to empty it. Upper left, an unloader tilts a box car lengthwise so grain is shaken out of it.

MODERN car unloaders can seize a railroad car as if it were a match box and turn it bodily upside down or tilt it on end. They enable one man to empty a car in from one and a half to four and a half minutes, replacing the unloading crew usually required.

The unusual photographs shown above give a glimpse of two of the latest types in operation. One dumps flat cars of coal, sugar beets, or iron ore. Giant clamps lock the car to the rails while the whole carriage revolves ponderously on its axis. When the car is upside down its load falls out into a hopper.

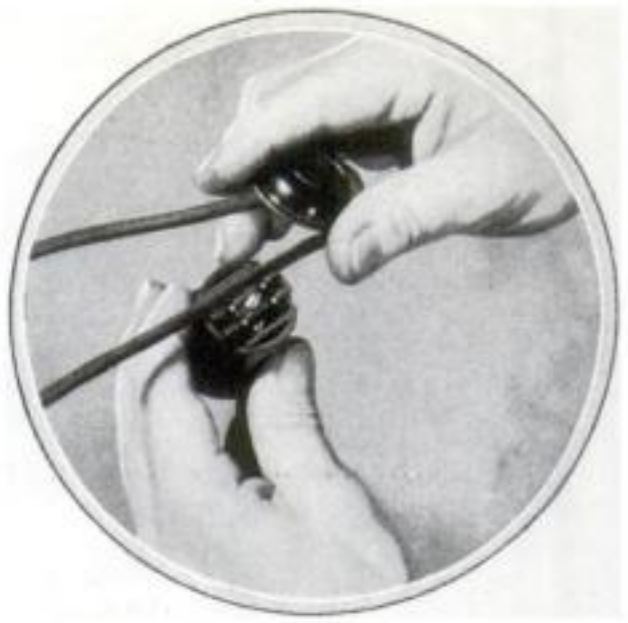
The other unloads box cars of loose grain through an ingenious system. After the car is locked in place, the platform tilts slightly toward the side on which the door is opened. Then the car is rocked back and forth as shown in the upper photograph. This shakes out practically all the grain. The last is removed by inserting a baffle board that deflects grain running past the door, while the car is given a final tilt by the mechanism.

BABY NOW GETS PULLMAN BED IN AUTO

A frame fitted into the rear seat of the auto makes a Pullman bed for baby from which he can not fall.

WHEN a mother goes traveling she can now take her baby with her in the back seat of the car. A device just placed on the market converts the rear seat into a small pullman bed in which the baby lies.

The framework is of steel covered with upholstery to match that of the car. Two snap sockets hold the frame to the floor and two strong straps with snap fasteners lead to concealed screw eyes in the corners of the car. The frame can be placed in position or removed in a few seconds. High sides keep the baby from falling out if he becomes restless.



NEW SOCKET CLAMPS TO INSULATED WIRES

INSTALLING additional electric lights in cellar or closet is made easy by a new type of electric socket. It is attached directly to the wires without stripping the insulation from them.

When the two halves of the socket are brought together upon the wires and screwed tight, a pair of sharp metal points pierce the insulation and make a permanent contact with the current-carrying strands. It takes but a few seconds to twist the socket on or off.

GLOBE DESIGNED AS RADIO CABINET

SO THAT radio sets may be heard but not seen, Albert Aurili, a sculptor, of Lake Worth, Fla., has designed a cabinet which is a globe map of the world. Cast in halves, it is arranged to open on hinges, to tune or inspect the set.

This new radio cabinet is supported at its poles, at which points the wires are led inside. It should prove a convenience, says the inventor, when receiving news broadcasts. The user could easily find on the cabinet itself different parts of the world mentioned, without having to leave the radio to look them up elsewhere.

MOSQUITOES ROUTED BY MIXTURE ON WRISTS

AN UNUSUAL convenience for hunters, fishermen, and campers is a tube of anti-mosquito mixture which is worn strapped to either wrist. The tube is small, not much bulkier than a good-sized wrist watch, so it does not interfere with outdoor pastimes.

From time to time, as the little buzzing insect pests begin to crowd around, a small quantity of the tube's contents are squeezed onto the back of the wearer's hand. Since the mixture has a strong pungent odor said to be intolerable to the insects, they immediately go away from there, to seek their meals in a more favorable locality.

USE MECHANICAL FLY TO WARN OF GERMS

SCIENTISTS at the U. S. Department of Agriculture have just completed a huge mechanical fly. It will go on exhibition soon, in an educational tour to illustrate the way in which insects spread germs.

While lifelike models of insects and animals have been constructed before by Uncle Sam's workmen, this is their first excursion into the mechanically animated insect world. The fly is large enough to house within its own body the motor and machinery necessary to operate it.

OIL TANKERS AT SEA GET PRIVATE LANES

SEPARATE sea traffic lanes for oil tank steamers are to be tried off the eastern end of Long Island as a safety measure. Cargoes of oil carried by tankers, whose courses converge and mingle with those of passenger steamers at this point, might become a menace to the life and property in the event of collision. So the oil carriers are being given a private lane for their own exclusive use.

WIRELESS WALL LIGHT FOR CLOSETS

A NEW light designed for use in dark closets and cupboards requires no wiring. It works on self-contained dry cells. Lamp and battery are contained in one mounting, held in place by a couple of screws. This novel little fixture gives a light strong enough to read by, and, with moderate use, its battery will last for several months.

This wireless light, for use in dark closets, attaches to the wall and is operated by long lasting batteries.

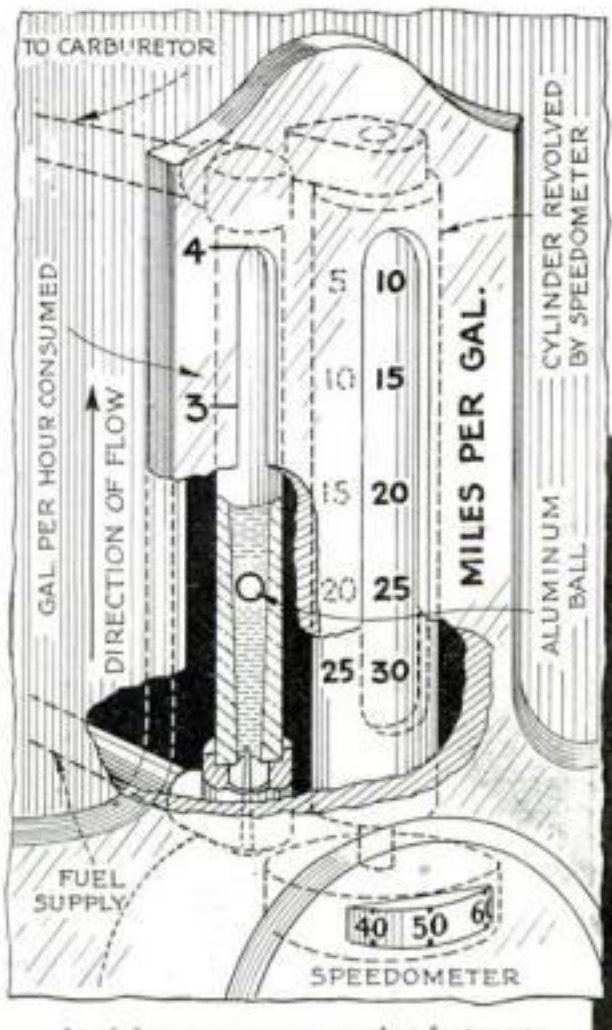
ONE ANTENNA FOR MANY RADIO SETS

FAMILIAR to city dwellers are apartment building roofs cluttered with a motley collection of radio antennas connected to individual sets below. But a new system developed by a well-known radio firm makes these laboriously erected and unsightly aerials unnecessary.

A single, scientifically built antenna of entirely new design is installed on the roof. It feeds all the radio receivers in the building — as many as 200, if desired—and each set owner may tune in to any desired station irrespective of the other receivers using the same antenna and without interfering with their reception.

The single lead-in wire from the antenna is led to a penthouse, where it is connected to an amplifier. From this point, a flexible cable, less than three eighths of an inch in diameter, literally pipes the radio signals to special wall outlets in every apartment. The dweller has only to plug in his radio set to the wall plate, which also contains a ground connection in addition to a socket from which electric current to operate the receiver is taken.

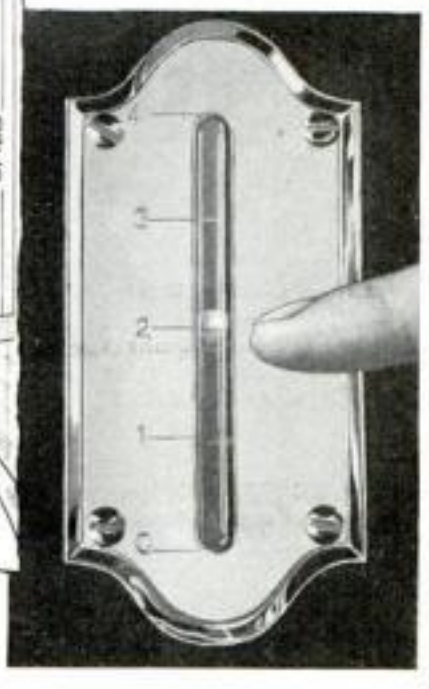
GAGE SHOWS GAS YOUR CAR USES



At right, a new car gage that fastens to dashboard and shows how fast you are burning gas. Diagram shows operation.

A GAGE for autos, designed by a Camden, N. J., inventor, tells the driver how fast he is burning gasoline in miles per gallon or in gallons per hour. The diagram at the left shows the gage's operation.

On its way to the carburetor, the gasoline is forced through a tapered glass tube on the dash. The tube contains a colored ball of smaller diameter than the lower end of the tube. As the gasoline goes through the tube, it tends to carry the ball with it. The higher the ball goes, the greater is the opening around it and the more gas is able to flow past it. The ball therefore rises only so far for any given rate of flow. Figures mounted on a drum that rotates with the speed dial of the speedometer give a direct reading of the miles traveled per gallon of gas.

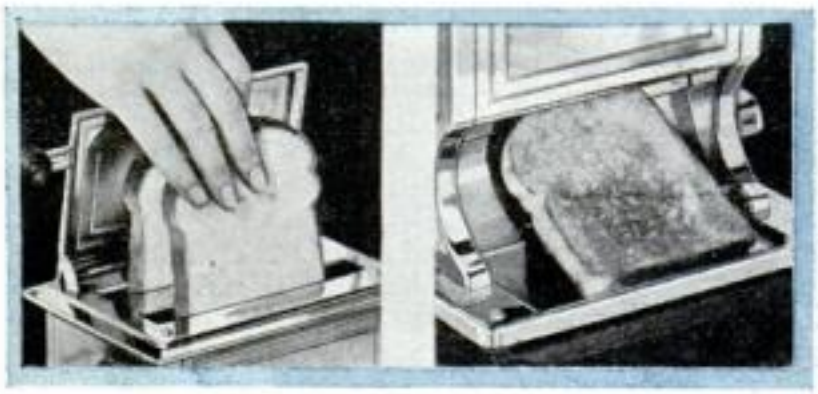


New Ideas for Your Home

Here Are a Dozen Devices to Give the Housewife Less Trouble with Her Work and Aid Domestic Comfort and Cleanliness

ANSWERS DOORBELL FROM KITCHEN. Now the housewife need not interrupt her work to go to the door when the bell rings. Mike and loudspeaker let her talk to caller from the kitchen.

FLOOR OIL IN TANK. This new idea for a floor oiler does away with the frequent trips to the supply can and enables the housewife to get her floor cleaned quickly. The tank on the handle holds three quarts and by means of a flexible tube is fed continuously to the woolen applicator, which may be removed for cleaning. It is easy to get a smooth coating as the cloth at all times contains the same amount of oil.



SELF-CLEANING TOASTER. Crumbs can't stick in this new automatic toaster. The toast slides out at bottom, taking the crumbs with it.

LIGHTS FOR HOUSE NUMBERS. Miniature lamps connected with a doorbell circuit using house current lights the house-numbers at night. Pressing the button short-circuits the light wiring and rings the doorbell.

ALL MOTHS HATE IT. When this device, right, is hung in a clothes closet moths go away from there. An anti-moth liquid drips constantly from the inverted bottle and falls upon a felt pad. Its pungent vapor smells of cedar.

NO ANTS IN THIS CABINET. Insect pests are securely shut out of this built-in cabinet in which the shelves are on a revolving rack. Oil bowls exclude ants.

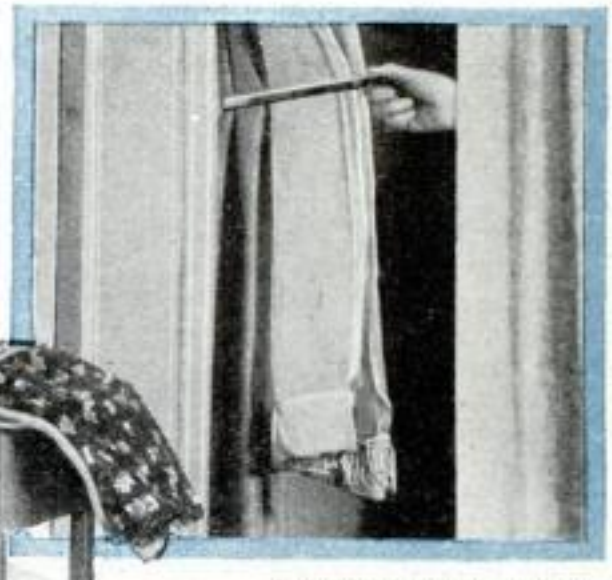
HANDY TWO-IN-ONE. One hand will work this dustpan and broom with which there is no stooping. Pressing the handle down sweeps dust into the pan.

BURN YOUR CORNCOBS. In the sections of the country where corncobs are a convenient fuel this kitchen cabinet provides a clean and handy receptacle in which to keep them.

COLLAPSIBLE VANITY TABLE. Where rooms are small or crowded, this folding vanity table should be welcome. When not in use, it can be put out of the way and occupy little room, as at the right.

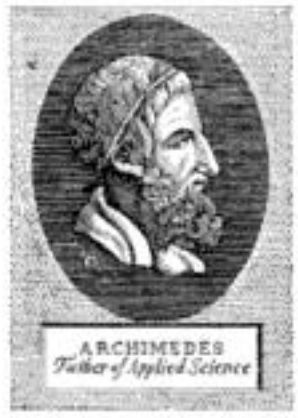
SAVE THE MILK. Asbestos covers for the milk bottle are said to prevent souring in summer and freezing in winter. The covers are washable and are easily slipped over bottle.

SANDWICH TRAY OR PLATE. Any plate can be turned into a sandwich tray by simply snapping on this ornamental handle as shown.



PROTECTS CURTAINS. This attractive pair of hinged metal rods will keep your curtains from fluttering in the wind and thus save them from dust and rain. Once put over the rods, the curtains cannot fly loose. The bars are fastened to the side of the frame.

POPULAR SCIENCE MONTHLY



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The Truth About Aviation

WHEN Lindbergh crossed the Atlantic in a solo flight, he fired the popular imagination and became a national hero. The reflected glory of his achievement enveloped all aviation and became the impetus for the biggest boom that industry has ever known.

Today, as Lindbergh's name has practically disappeared from the big headlines in the papers, aviation, too, seems to have taken a back seat. Superficially, it looks as though the aviation craze had vanished and interest in flying was dwindling. Is that true? Most emphatically we say, "No."

Naturally aviation is suffering from the general business depression, but in this industry the depression is relative, not actual. Judged by the standards of its own progress, aviation is still going ahead at a remarkable rate. True, general business conditions may have retarded that advance, but the figures tell the true story and they prove the growth is still rapid.

For example, 165,000 passengers rode in air transport planes in 1929, which was three times the number carried in 1928. In 1930, 400,000 passengers rode in transport planes—a gain greater than the total number carried in 1929.

The increase in airplane express, in spite of the depression, is equally amazing. In 1929, 258,000 pounds were carried; in 1930, 718,000. If there is anything about these figures that indicates a slowing up in aviation, we'd like to know what it is!

Lindbergh hasn't been breaking any records lately, but that doesn't mean that no records are being broken. Duration flights which originally were tests of the durability of an airplane motor have been pushed to the point where they no longer mean much as motor tests.

MADDELENA and Cecconi in Italy last year stayed in the air over sixty-seven hours without refueling, and Jackson and O'Brine in this country flew continuously for nearly a month with the aid of a refueling plane.

Endurance tests are no longer in style because motors and planes have progressed to the point where it has become a matter not of mechanical but of human endurance.

Careless reading of the papers is quite likely to give you the idea that flying, instead of being far safer, is actually becoming more hazardous. That is because every airplane fatality goes on the front page.

Yet the figures show that there are 500,000 flights for every airplane accident, however trivial. Twenty million miles of scheduled flying operations in the United States for the eight months prior to March first, last, resulted in only four deaths. On that basis you'd have to fly 20,000 miles a year for 258 years before it came your turn to get killed!

Nearly thirty different inventions or improvements in the art and practice of aviation since the beginning of the business depression have helped to establish this astounding record of safety.

No matter what feature of aviation you investigate, you will find that substantial progress has been made during the period of business depression. Take airports, for example: There were 733 in the United States in 1928. The number in 1929 had grown to 916, and there are now well over 1,100 places in the United States where an airplane may land, receive service, and take off again.

THIS number does not include the many private flying fields. There are now over 16,000 miles of airways in this country lighted suitably for night flying, a great increase over previous years.

There are just two spots in the general record that, while they show increases, have not kept pace with the progress in other directions. One of them is the air mail. The increase last year was only a million pounds. However, you can't blame aviation for that. The number of letters people send depends on general business, and if business is depressed, there will be fewer letters mailed—especially the rush letters that mean rush business. Merchants are not likely to spend extra postage for air-mailing their orders when they are having difficulty in selling the stock on hand!

The other soft spot is the number of airplanes in private use. There are about 5,000 privately owned planes now as against 4,000 last year and 3,000 the year before that. This shows a growth of about a thousand a year. With a total population of about 120,000,000 people, this seems like a mighty small number of privately owned machines, and it is until you stop to consider the question of cost. Even a medium small standard two-passenger airplane suitable for private use costs as much as a really deluxe automobile.

Air transport figures prove that people are eager to ride in airplanes. It is claimed that about four percent of the population actually rode in them last year.

There has been a great increase in the number of licensed pilots. There are 16,000 now. There were only 11,000 in 1929 and about 5,000 in 1928.

Many of these pilots are now looking for jobs. The young man considering aviation as a future career may think this is a good reason for staying out of it. But a little thought will convince you that your reasoning isn't good. While it is true at present in aviation that only an experienced man has a chance for a job, the same thing is true in many another line.

During any depression the beginner has a tough time of it. You can go into aviation as a career today with the assurance that while you may have a tough struggle, you will not be any worse off than you would be in some other line.

We Rile the Reds

REACTIONS differing as much as day and night were stirred up by Michel Mok's articles on Russia, which appeared in our April and May issues. Hundreds of letters were received from readers of this magazine. Some denounced us as champions of the Communist cause, while others praised us for "presenting an interesting situation from an unbiased standpoint." As that was one of the two aims of the articles, those latter comments naturally gratified us.

The other and principal purpose of the stories was to show that whatever progress the Russians have made in the execution of their Five-Year Plan for changing their country into an industrial nation has been due largely to the efforts of American engineers who are directing big jobs in Russia today.

Evidence that there, too, we hit the bull's-eye now comes from Russia itself. In a recent issue of the Russian railroad paper, *Gudok*, POPULAR SCIENCE MONTHLY is taken severely to task for giving the American engineers most of the credit.

Under the caption "American Self-Esteem and Soviet Performance," the Bolshevik trade paper declares that the Russians now are able to paddle their own canoe. Only a few days ago, a statement issued by the Soviet government asserted that the great new tractor plant at Stalingrad had practically broken down as a result of the inefficiency of Russian workmen. Thus we feel justified in interpreting *Gudok's* attack as a sincere compliment.

Home Radio Records Are Now Easy to MAKE

New Equipment for Private Use Gives Reproduction That Is Practically Perfect

By ALFRED P. LANE

A FEW months ago one of the prominent radio manufacturers put out a radio phonograph model fitted with a home recording attachment, suitable for recording radio programs or the efforts of home musicians and elocutionists (P.S.M., Feb. '31, p. 83). It met with a surprising response. Now a still more elaborate apparatus has been introduced that gives results closely approaching those obtained with fine equipment in the regular sound recording studio.

In the simpler forms of home sound recording systems, special blank grooved records are used. These have a perfectly smooth groove cut into the wax. The material of which the special record is made is considerably softer than the standard phonograph disk so that a special, blunt pointed needle, when passed along the groove, will deform the edges of it according to the voice or musical vibrations that are actuating the needle.

The principal difficulty with this system is that the central line of the groove is not altered. As the needle moves from side to side it pushes out first one wall and then the other. In consequence the path of the needle when run through the groove again to reproduce the recording does not, because of the opening up of the groove, duplicate its original recording path.

IN MAKING studio records, the recording needle actually cuts the groove in a perfectly smooth blank record. This seems to be the only way to get true reproduction. Unfortunately, the apparatus used in the studio to move the needle across the record is too heavy, complicated, and expensive for amateur use.

A simpler form that accomplishes the same result is shown on these pages. While the outfit shown in Fig. 1 is sold as a complete recording and reproducing unit, it is also possible to obtain the vital apparatus shown in Fig. 2 for use on any phonograph turntable. These parts consist of a special recording head and a drive mechanism.

Fig. 1. A recording and reproducing unit for home use with any phonograph turntable.

The recording head has a leather lined groove back of the cutting needle. On the other side of the rectangular compartment which houses the electromagnetic mechanism there is a knob-shaped piece of metal. Its function is merely to press the needle against the record surface with sufficient firmness to make it cut.

In use the recording head rests on the threaded rod of the drive with the leather lined groove pressing against the threads. Thus part of the weight is sustained by the threaded drive rod and the rest is on the needle point.

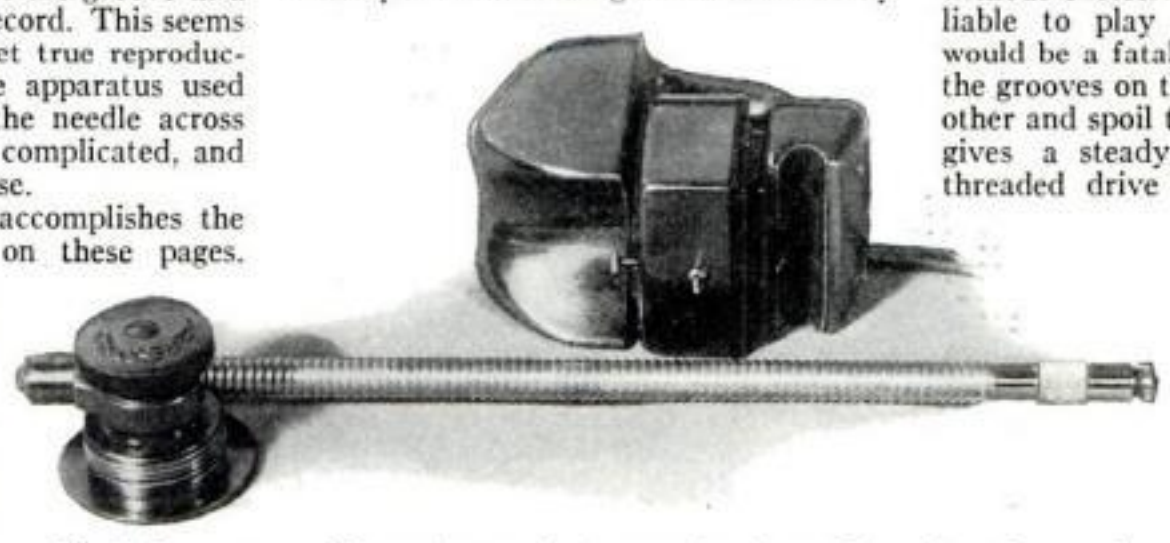


Fig. 2. Apparatus needed to make reproducing records at home. It consists of a recording head and a drive mechanism. The head rests on the threaded rod of the drive.

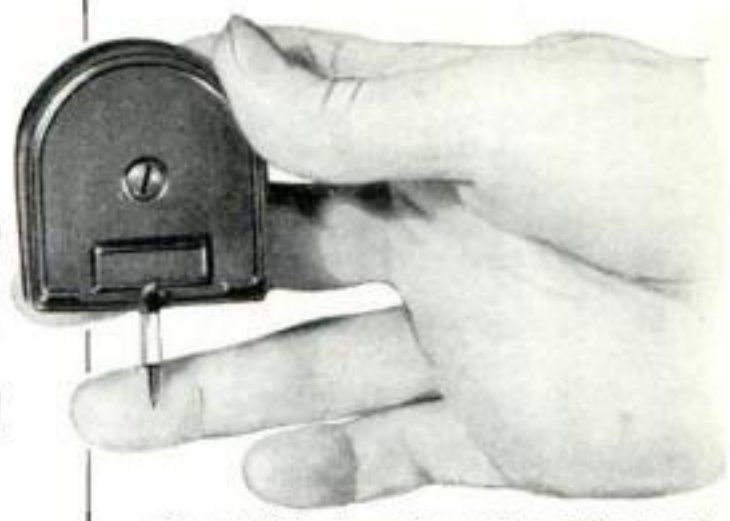


Fig. 3. This shows the needle used in recording—blunt and of bamboo fiber or of horn.

The drive mechanism fits over the center pin by friction, with the outer end of the threaded drive rod resting in a simple metal support that is screwed to the phonograph top beside the turntable.

AS THE turntable revolves, it rotates the center piece on the side of which are cut threads. These threads engage with a gear on the end of the threaded drive shaft and turn it at a slow rate of speed. Thus the recording head is carried toward the center of the disk as the needle cuts the groove, resulting in the usual spiral of standard pitch.

The records used with this type of recorder are of smooth sheet aluminum. Obviously, the ordinary type of steel phonograph needle cannot be used to play a metal record of this type. A suitable needle is of bamboo fiber or horn, and these needles, fitted in special rubber sockets, are obtainable to fit the hole in any standard type of phonograph reproducing head. This needle is shown in Fig. 3.

The use of the leather coated groove in the recording head and the threaded drive rod seems, at first glance, to be rather a crude procedure. It is, however, an ingenious way of overcoming two difficulties that would be encountered if threads were cut in the groove of a size to fit those on the drive rod.

TO BEGIN with, it would take extremely accurate thread cutting to make a thread that would allow the rod to turn without excessive friction and yet not be liable to play or looseness. Looseness would be a fatal defect, as it would cause the grooves on the record to run into each other and spoil the recording. The leather gives a steady, light friction on the threaded drive rod, which takes up all play in the worm and gear mechanism, which slowly rotates it.

In order to operate any home recording mechanism, it is necessary to have a turntable motor with a fair amount of driving power. Any of the standard type of electric turntable units has

enough for the purpose, but many spring operated motors, especially if they are old and the springs are gummed up and weak, will prove unsatisfactory.

Some experimenters with home recording apparatus have encountered difficulty because of the low amplification produced by the radio receiver used. Some modern sets only have one stage of audio amplification following a power detector. Such sets usually have such a high degree of radio-frequency amplification that excellent results are obtained in radio reception, but when a phonograph pick-up of the electric type is used to play records electrically, or recording is attempted with homemade apparatus, the results are poor.

Powerful audio amplifiers, built as separate units, can be obtained now to meet these requirements or for use in any type of hook-up where it is desired to operate one or more loudspeakers from a centrally located microphone as in schools or public halls.

While the most important use of home recording undoubtedly will be to record exceptional radio programs so they can be replayed, and the making of records of home produced musical and vocal entertainment, there is also a wide field of usefulness for educational purposes. The educational programs sent over the radio could be recorded at the school and reproduced at different classes. Again, the lecturer, by making records, could deliver his lecture in several places at once.

New Tubes for Special Uses

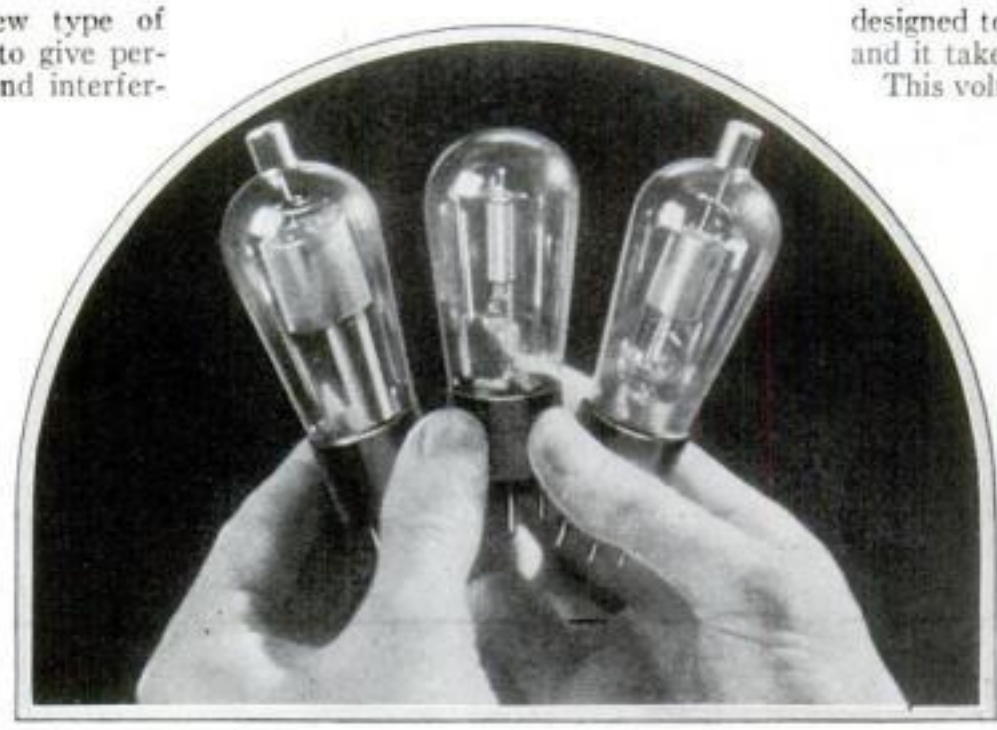
IN ADDITION to the new type of screen grid tube designed to give perfect volume control and end interference at low volume levels announced last month (P. S. M., June '31, p. 81), four more new type radio vacuum tubes will soon be available.

The most important is the new type 247. This tube is, in effect, a power tube like the type 245 now universally used in modern electric receivers, with added elements in the form of two screens that give it remarkable amplifying qualities in addition to its power handling ability.

Borrowing from screen grid practice, the engineers have found that a screen placed outside of the control grid and supplied with voltage equalling that connected to the plate circuit will greatly improve the amplifying qualities. In addition there is another screen just inside the plate. This screen is connected inside the tube to the filament.

The function of this screen is to prevent electronic emission from the plate, a phenomenon that limits the power handling ability of the ordinary type 245 tube. In popular language, this screen is a one-way trap. It repels the electrons knocked off the plate by the heavy stream of electrons flowing from the filament and makes them go back to the plate again instead of traveling toward the grid and filament and thus upsetting the operation of the tube.

THIS tube probably will be widely used next year, not because it makes possible better radio reception, but because it makes good reception a lot cheaper. Up to now the standard high quality circuit has consisted of a radio-frequency amplifier, a detector, and an audio amplifier made up of one stage of resistance or transformer coupled amplification feeding into a push-pull circuit using two type 245 tubes.



Here are three of the new radio tubes. From left to right they are 236, 237, and 238. Using two 236 and one 237 and one 238 gives a set with four tubes.

The new type 247 tube gives so much more amplification and has so much more power handling ability that it alone will do nearly as much as the three tubes now used. Obviously, the new tube is of no interest to owners of sets fitted with the present circuit because a set using the new tube will not give them quite as much as they are now getting, but radio listeners who have older type sets will find that they can get a set with modern operating qualities at a lower price than ever before.

The most important new tube is type 247. In effect, it is a power tube like type 245. In addition, two screens give it remarkable amplifying qualities.

THE other three new tubes are of interest only to prospective buyers of radio sets to be fitted to automobiles or to be used in homes supplied only with direct current electricity for lighting.

The type 237 roughly corresponds in radio receptive characteristics to the 201A, the 227, and the 230. It is a general purpose tube. Its chief new characteristic is a heater type filament designed to run on 6.3 volts direct current and it takes only .3 of an ampere.

This voltage is such that the tube can be operated from the lighting circuit of the car without the use of any controlling rheostats or special resistances. The tube uses far less current than the 227, and yet because it is of heater type, it will cause much less interference from the ignition circuit than the 201A tube.

WHEN used in sets designed to operate on 110-volt direct current, the heaters of several tubes can be connected in series and only about thirty watts will be drawn from the line.

Another of the new tubes is the type 236, which electrically is exactly like the type 232 screen grid two-volt tube except that it is fitted with a heater filament that draws .3 amperes at 6.3 volts, the same as does the type 237. Obviously it has the same relative advantages in auto sets or sets designed for direct current.

The fourth of the new tubes is type 238. Electrically this tube is a smaller copy of the new type 247 described above. It has the same two extra screens. Its filament is, however, of the heater type taking .3 amperes at 6.3 volts. Instead of 250 volts applied to the plate and screen grid as is required for the type 247, the type 238 takes 135 volts on these electrodes.

It seems safe to predict that there soon will be some satisfactory low priced radio receivers on the market for automobile use and in homes with direct current.

For example, not more than two of the screen grid tubes type 236 in a radio-frequency circuit followed by a type 237 used as a detector feeding directly into a type 238 power tube acting as an audio amplifier would give a set using only four tubes. It would have plenty of radio-frequency amplifying power to bring in distant stations even on a short indoor antenna and its power handling ability, while of course not equal to the full sized alternating current sets sold today, would still be ample.

When used in an automobile, such a set would draw only 1.2 amperes from the storage battery, or less than half that required to light one of the front lamps.

HELPFUL HINTS FOR RADIO FANS

Watch House Voltage and Save Your Tubes

SOME day tubes for electric type radio receivers will be made so tough and durable that no ordinary change in the house lighting voltage will affect either their durability or their operating characteristics. However, that day has not yet arrived, and so it still is necessary to watch out for abnormally high or low voltages.

When you buy a radio receiver from a responsible concern, the man who installs the set always makes it a point to measure the house voltage at the socket where the radio set is to be connected. If he finds it too high and there is an adjustment on the set to take care of it, he makes the proper adjustment. If there is no such adjustment, he insists on installing a voltage controlling device.

This procedure is correct as far as it goes, but it does not take care of such changes in the house line voltage as may occur after the set is installed. In one case, for example, the voltage at the wall socket averaged about 108 when the set was installed.

A few months later, the power company shifted its lines in that neighborhood and installed a new and larger pole transformer to take care of probable increased future demand. About a month after that the set owner had several tubes burn out in quick succession.

A check-up showed that the voltage at the wall socket had been increased nearly to 130 volts. Such a radical change would be unlikely in a large city but often occurs in suburban sections and small towns.

UNFORTUNATELY, a radio set gives no indication of voltage increase. Unless you have the house voltage checked at regular intervals, the first intimation you will have of an increase in house voltage will be the burning out of tubes.

Figure 1 shows a simple cure for excessive voltage that can be adjusted to take care of any increase. Obtain a porcelain socket and a 500 or 600 watt heating element of the type used in the ordinary copper bowl electric heater. Cut one of the wires in the drop cord and connect the severed ends to the socket terminals. Having done this, screw the heating element in place as is indicated in illustration at right.

If the voltage reduction is so great that the operation of the receiver is affected, reduce the number of turns in the heating element and reconnect as shown in the illustration. The heating element should, of course, be mounted in and carefully insulated from a metal box that has openings in it for adequate ventilation.

Fig. 1. A porcelain socket and a heating element will protect tubes from high voltage.

DOUBT YOUR EYES

PERHAPS the simplest connections in the radio circuit are to antenna and ground, yet these cause trouble for thousands of radio listeners. The ground connection is the worst offender.

Unless the surface of the pipe to which the connection is made is scraped or sandpapered right down to the shiny metal, corrosion will take place and the radio receiver will develop queer scratchy noises that spoil the broadcast reception.

Sometimes the corrosion leads to an intermittent connection. For several days it may work perfectly, then without warning the volume drops and a hum develops. The following night the connection may have reëstablished itself.

Never trust your eyesight to determine whether a ground or antenna connection is good. It may look perfectly solid and even feel that way when you try to move it with your fingers and still be in a badly corroded state underneath.

A B C's of Radio

THE growth of radio broadcasting, talking movies, and electrically operated phonographs has revolutionized the manufacture of electrical resistance units. The demand for high resistances amounted to almost nothing before broadcasting. Now resistance units of all values up to many millions of ohms are made in large quantities. In early types of radio receivers, the only resistances used were simple rheostats of a few ohms each and a grid leak which, for lack of something better, usually consisted of pencil marks drawn between two binding posts. Now dozens of resistance units form vital parts of every modern radio receiver's circuit.

Fig. 2. The right and easy way to use a mill file to reduce any material to the desired size.

SUMMER COMPLAINTS

EVERY year, about this time, service men receive calls from owners who think their radio sets are out of order. Those who bought their sets last winter are beginning to discover that the distant stations they brought in so easily during the cold weather can no longer be heard.

When they turn to the proper dial numbers for these distant stations and turn up the volume control nothing happens except a regular artillery barrage of static from the loudspeaker. Not realizing that distance radio reception is always poor in the summer and that static is much worse, they naturally assume that something has gone wrong with their receiving equipment.

FILING THIN PANELS

IN AMATEUR radio construction work it often is necessary to file the edge of a composition panel to fit it to the cabinet, to take a bit off the edge of a sheet of metal shielding, or even to remove some material from the edge of a plywood piece used as a base or sub-base. The quickest and most satisfactory way to do such a job is to remove the material with a power sanding disk.

However, most radio experimenters do not seem to go in for power driven shop equipment and so such work has to be done by hand. Whether the material is composition, plywood, or metal, the easiest way to do the job by hand is to take a mill file, place it at right angles to the material, and with a hand on each end of the file move it back and forth lengthwise of the work, not crosswise.

"There's no such thing as a frictionless bearing," Gus said. "Nobody ever made one and nobody ever will. A ball bearing comes close to it, but even a ball bearing has friction."

Gus Gives You Facts About Car Bearings

By MARTIN BUNN

"TAKE a look at that, Joe," Gus Wilson said, pointing to the main bearing surfaces of a motor on which he was working. "That's about as nice a job of bearing scraping as I've done in many moons."

Joe Clark, his partner in the Model Garage, glanced at the journals of the crank shaft resting on blocks beside the engine and noted the Prussian blue that coated them. Then he saw how the blue, that rubbed off from each journal, covered nearly the entire surface of each bearing and its cap.

"Golly!" he exclaimed. "That's fitting 'em close. I'll bet you couldn't squeeze a hair from a fly's eyebrow anywhere into those bearings. They ought to run without any friction at all."

"There's no such thing as a frictionless bearing," Gus retorted. "Nobody ever made one and nobody ever will. A ball bearing, if its just right, comes pretty close to it, but even a ball bearing has friction. These bearings will have more friction for a while now than they did when they were loose."

"If that's so," Joe asked, "why waste so much time getting them perfect? Why didn't you just file off each bearing cap so it would fit closer to the crank shaft? That would have taken out the play and got rid of the thumping."

The veteran auto mechanic grinned as he polished off the blue with a piece of clean waste. "I'm ashamed of you, Joe, for suggesting a bum job like that. Don't you know that a bearing that really fits lasts about six times as long as a sloppy job? Trouble is, you don't understand how a bearing really works.

"Take this crank shaft. It'll run tight for a while, then a tiny bit of wear will make it really perfect. After that the oil will form a film over the whole surface of each bearing, and being the same thickness, the pressure won't break it down in spots. It'll be almost like a ball bearing, then, only instead of steel balls, the shaft will roll on particles of oil."

JOE settled himself comfortably on the workbench and opened his lunch kit. "Seems to me," he observed, "that they ought to fit ball bearings all through an automobile motor. That would save all the trouble of fitting plain bearings. You say ball bearings have less friction."

"If they could make ball bearings out of rubber," Gus grumbled as he dragged out his own lunch kit, "that would be a swell idea—maybe. How are you going to slip the ball bearings around the corners of a crank shaft to get them in place? Of course you could make the races in two pieces but there'd be extra wear at the joints.

"No," he continued, "I don't look for ball bearing crank shafts and connecting rod bearings for quite a while yet. To begin with, ball bearings are always noisy at high speed. They make a sort of steady roaring noise. Imagine what a modern eight would sound like when you go whizzing along with nine ball bearings on the crank shaft and eight more on the connecting rod big ends. You'd think a hurricane was blowing.

"ANOTHER thing: one of the biggest advantages of ball bearings is that you don't have to be putting oil on them all the time. That doesn't mean anything in the crank case of an auto motor because as long as you've got pistons sliding up and down you've got to have a steady supply of oil. Besides, the main friction in an auto motor is caused by the pistons and you can't make them ball bearing!"

"How about roller bearings? Do they make a noise too?" Joe asked.

"At high speed they do," Gus replied. "Someday we'll get a ball bearing salesman and a roller bearing salesman together and let 'em argue it out. Far as I can see there isn't an awful lot of difference between ball and roller bearings any place in a car if they're made big enough to stand the job. Point is, each type of bearing—plain, roller, or ball—is good if it's used in the right place.

"TAKE the generator, for instance. A lot of 'em are made now with a plain bearing at the drive end and a ball bearing at the commutator end. That's because the drive end gets oil all the time from the timing chain case and the car makers know that most motorists won't bother to oil the other bearing; so they put in a ball bearing that will run for a long time with almost no oil. On cars that drive the generator with a belt, they usually put ball bearings at both ends because they know that neither will get the attention it should.

"Of course," he continued, "all wheel bearings now are either ball or roller bearing. I can remember years ago driving many thousands of miles in a car that didn't have a single ball or roller bearing. Even the wheel bearings were plain. Whenever we drove by a swampy place at night, we never could tell whether the squeaking was frogs or a wheel bearing gone dry. Hardly a trip went by that we didn't have to get out, take a wheel off, and smear cup grease on the axle.

"Speaking of bearings and lubrication," Gus went on with a reminiscent chuckle, "that old bus had a lubricating system that was at least twenty-five years ahead of its time. On the dash was a big brass cylinder—an enormous grease gun—with copper pipes radiating all over the car. By turning the lever you could send grease to any one of a number of bearings, and, believe me, you had to do that quite frequently if *(Continued on page 125)*

Gus Says—

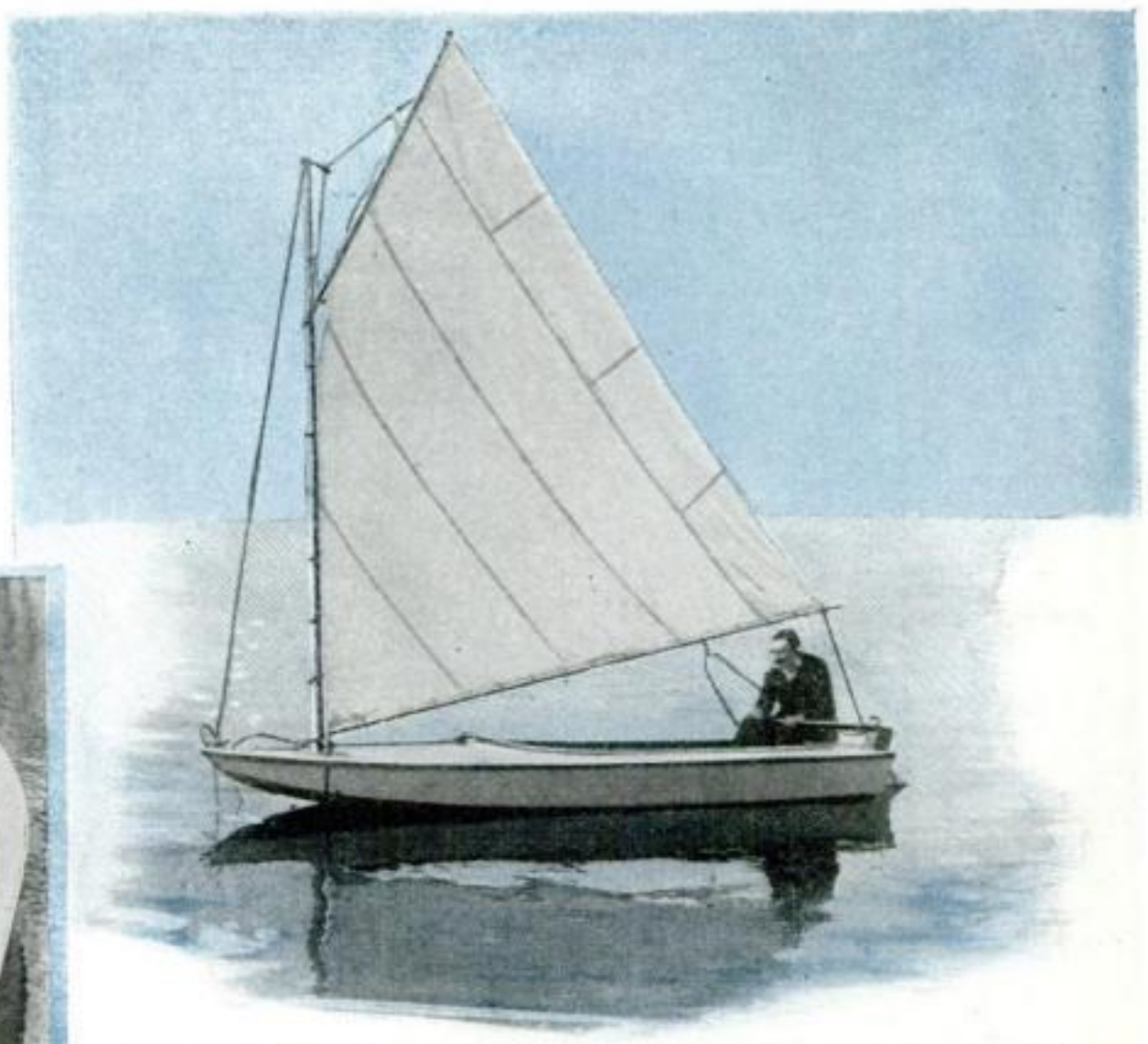
SOME auto owners admit they know little about the "works" of an automobile. Others brag about their dumbness. They actually seem to be proud of being ignorant. The boastfully ignorant bird is easy picking for the phoney auto repair shop because the crooked mechanic knows he can soak an ignoramus and get away with it. If you don't know anything about automobiles, for the sake of your pocketbook keep it to yourself!

BETTER SHOP METHODS • NEW IDEAS FOR THE HANDY MAN • BLUEPRINTS

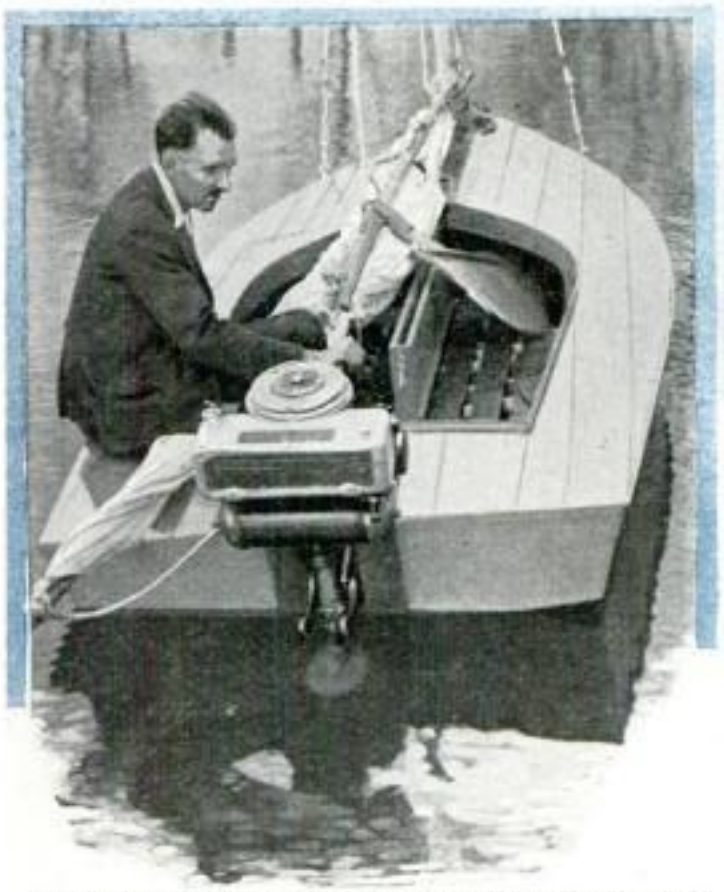
MODEL MAKING • HOME WORKSHOP CHEMISTRY • THE SHIPSHAPE HOME

Speedy New Sailboat-Motorboat Gives *All-Around* Sport

By WILLIAM JACKSON



Under sail, *Dauntless* is not only safe but exceedingly speedy for a boat of her dimensions. She is easily controlled and does not tend to hang in the wind or "yaw."



Mr. Jackson tested the boat with several classes and makes of motors and found it both fast and seaworthy.

THIS new combination motorboat and sailboat affords more diversity of recreation and more genuine pleasure on the water than any one-purpose boat. She is so useful, versatile, stanch, and fast that she well deserves the name *Dauntless*.

Designed especially for POPULAR SCIENCE MONTHLY readers, this craft is no makeshift or haphazard combination, but represents a carefully studied effort to produce a boat that will give satisfactory service with either sail or power. Unlike many sailboats, she draws very little water and is not heavy; and when propelled by an outboard motor, she does not squat and drag.

Dauntless is 15 ft. long and has an extreme beam of 5 ft. 5 in. She is fast under power, and her beam makes her seaworthy. In our tests this craft proved faster than either round- or flat-bottomed rowboats powered with small outboard motors. The following are the motors adapted to this boat and the speeds:

Class "A," 2 to 8 H.P.— 8 to 15 M.P.H.
Class "B," 12 to 16 H.P.—12 to 18 M.P.H.
Class "C," 18 to 25 H.P.—15 to 25 M.P.H.
Class "D," 24 to 32 H.P.—20 to 28 M.P.H.

Should the boat be used solely as a motorboat, the sail can be either dismantled or dispensed with.

If you have ever skimmed over sunlit waters, sheet and tiller in hand, you know what fine sport there is in sailing. But motorboating has its thrills, too; and a motor always gets you there! By building this boat, you can enjoy both these sports.

If you are a confirmed sailboat "bug" and look upon motorboats as a landlubbers' craft, well and good. *Dauntless*, besides being safe, sails extremely fast for a boat of her dimensions. It requires but the slightest effort to control her under sail. When going about, a push on the rudder spins her around, and you are off on another tack. She does not hang in the wind and "yaw" about like many of her kind.

At times the wind is fickle. If you are becalmed, unship the rudder, attach the trustworthy outboard that you have provided for this purpose, and you are home-

ward bound in safety and solid comfort.

If you wish to go fishing or have taken this roomy little packet on an outing or camping trip and find it necessary to go for camp supplies merely attach the outboard motor to the permanent motor board and you can be on your way.

The end of the summer does not necessarily mean that the craft has to be stored. By unshipping the mast, sail, and rudder, and attaching the outboard, you have an excellent hunting or duck boat.

The original hull without sails, spars, and rudder weighs 300 lb.; completely equipped, *Dauntless* weighs 365 lb. The boat is light enough to be transported on a trailer if desired. The complete boat including sails cost the author $65.

To realize all these advantages, we must set to work to build her. The construction is not difficult; and to make the work as easy to lay out as possible, three blueprints have been prepared with larger drawings than it is possible to publish within the restricted limits of a magazine page. In effort saved, you will be well repaid by sending for these prints, the price of which is seventy-five cents (see Nos. 131, 132, and 133 in the list on page 117).

Anyone familiar with carpenters' tools can turn out a creditable job. The woods suggested in the material list should be easy to obtain locally. If you are in doubt as to where to obtain the necessary hardware and fastenings or the sail cloth or sails, send a self-addressed and stamped envelope to the Home Workshop Department for a list of dealers.

Study the plans and instructions carefully before beginning. Some of the pieces are not mentioned in the material list, but they can be cut from the waste lumber.

The first step is to make the form upon which the boat is to be built. This can be constructed from any rough 2 by 10 in. lumber. The form is made in two pieces as shown. With legs nailed on, it makes an excellent support for the hull.

The full size paper patterns for the frames are next prepared. Draw a center line on each sheet of paper and measure from it, laying out complete frames.

With the patterns finished, lay the ¾ by 2¾ in. frame material on the patterns so as to conform to the outlines, and mark and saw out the parts. The two bottom members of each frame are joined in the center with a ¾ by 3 by 12 in. block. Each of these blocks is coated with glue and fastened to the frames with ten 1¼-in. No. 8 flathead screws. Do not, however, glue the blocks of frames Nos. 5 and 6 as these blocks will be removed when the centerboard well is installed.

Number the frames to avoid confusion. Fasten the side member of each frame to the bottom member with two ¼ by 1¾ in. carriage bolts. Before attaching frame No. 10 to the transom, saw out the chine, inwale, and keel notches. Secure it to the transom with glue and 1¼-in. No. 8 flathead screws spaced 4 in. apart.

The frames are now assembled in their

As shown in the view above, the framework is assembled bottom up on a heavy form mounted on legs like a sawhorse. The frames fit in slots in the form. *At right:* Planing bevel on chine.

Working drawings of the assembled framework, the form upon which the boat is built, and the individual frames and keel. Larger views and a number of supplementary sketches are contained in Blueprints Nos. 131, 132, and 133 (see page 117).

respective places on the form. Clamp the keel temporarily to the form. Lay a light batten along the frames and mark the bevels. Remove the frames and bevel the edges. Frames Nos. 1, 2, 3, and 4 will be beveled the most; the rest are beveled but slightly. This is done so the planking will lie evenly on the frames.

Reassemble the frames on the form and fasten the keel to each frame and to the transom with two 2-in. No. 9 flathead screws. Countersink these screws so the keel can be beveled off. The stem is attached to the keel with two ¼ by 2¼ in. stove bolts. Nail strips from transom to keel to hold the framework square, and run strips from the floor to the frames.

The chines are now clamped in place and fastened to each frame with one 2¼-in. No. 9 flathead screw. Fasten both chines at once; that is, drive a screw on one side, then on the other. At the stem the chine is sawed to fit flush, and it is fastened to the stem with one 1¼-in. No. 8 flathead screw. When both chines are fastened, proceed to attach the inwales to each frame and to the stem with one 1¼-in. No. 8 flathead screw. Although indicated in the drawings as 1⅛ in. wide, a stronger frame will result if the inwales are made 1½ in. wide as suggested in the bill of materials. Bevel the keel and chines for the planking.

The ¾ by 1 in. intermediate ribs are now sawed to size and fastened in the exact center between each frame. Drill a hole in the chine and nail each intermediate rib to the chine with one 2-in. nail. The keel end of each intermediate rib is notched and fitted to the keel.

The complete frame is now trimmed and faired.

Next month Mr. Jackson will tell how to apply the planking and finish the boat.

MATERIALS FOR *DAUNTLESS*

Centerboard, 1 pc. ¾ by 14 in. by 4 ft., cypress, oak, or fir.
Planking and decking, 14 pcs. ½ by 6 in. by 16 ft., red cedar, white cedar, cypress, or white pine. Side planks, 2 pcs. ½ by 12 in. by 16 ft.
Frames, 6 pcs. ¾ by 2¾ in. by 10 ft., spruce or fir.
Transom, 1 pc. ¾ by 12 in. by 4 ft., spruce, fir, cypress, or white pine.
Deck beams, 1 pc. ¾ by 12 in. by 10 ft., oak, fir, or yellow pine. King plank, 1 pc. ¾ by 6 in. by 8 ft.
Centerboard case, 2 pcs. ¾ by 12 in. by 4 ft., fir, cypress, or white pine.
Intermediate frames, 7 pcs. ¾ by 1 in. by 8 ft., oak or fir.
Outside coaming, 2 pcs. ⅜ by 4 in. by 8 ft., oak, fir, white pine, red cedar, or mahogany.
Chines, 2 pcs. ¾ by 1¼ in. by 16 ft., oak or fir.
Keel, ¾ by 4 in. by 14 ft., oak or fir.
Inwales, 2 pcs. ⅜ by 1½ in. by 16 ft., oak, yellow pine, or fir.
Floor boards, 6 pcs. ½ by 6 in. by 8 ft., yellow pine.
Stem, 1 pc. 2 by 6 in. by 2 ft., oak, elm, or ash.
Mast step, 1 pc. 2 by 6 in. by 2 ft., fir, yellow pine, or oak.
Spars—Mast, 1 pc. 4 by 4 in. by 14 ft.; boom, 1 pc. 4 by 4 in. by 14 ft.; gaff, 1 pc. 4 by 4 in. by 8 ft., spruce, fir, or yellow pine.

FASTENINGS

6 gross 1¼-in. No. 8, 2 doz. 2-in. No. 9, and 3 doz. 2¼-in. No. 9 F. H. galvanized screws. (For salt water, use brass or bronze fittings.)
48—¼ by 1¾ in. and 1—½ by 4 in. carriage bolts.
1½ lb. 1¼-in. galvanized nails.
1 lb. 2-in. finishing nails or 4 gross 1¼-in. No. 8 F. H. gal. screws.

HARDWARE AND FITTINGS

3—¼ by 6 in. gal. turnbuckles.
1 No. 1105 screw eye.
5—¼-in. gal. blocks (pulleys), fast eye.
2—¼-in. gal. deck blocks.
2—No. 2 gal. rudder braces or hangers.
2—¼ by 2¼ in. and 2—¼ by 3¼ in. gal. eyebolts and 3—5-in. gal. cleats.
1—¼ in. by 3 ft. gal. iron rod.
6—4-in. gal. iron mast hoops.
½ gross brass grommets.
8—¼-in. gal. thimbles.
45 ft. ¼-in. gal. wire rope.
100 ft. ¼-in. Manila rope.
1 pc. ¼-in. gal. iron pipe, 24 in. long.
2—¼ by 2 in. lag screws.
1—7/16 by 6 in. lag screw.
2 pcs. ⅛ by 1 by 12 in. strap iron.
2½ lb. seam composition, 2 balls cotton calking (wicking), 20 yd. 6-oz. cotton sail twill, and 3 pt. waterproof glue (casein) or 2 lb. white lead. Paint and varnish.

Giant Checkerboard for Outdoor Use

THE old, familiar game of checkers, which everyone enjoys playing, can be transformed into a novel outdoor sport by constructing a giant concrete checkerboard like that illustrated.

Nail together four 2-in. planks about 1 ft. wide to make a bottomless box or form that measures 5 ft. square inside. Set this on the ground where the checkerboard is to be located, allowing it to slant slightly for drainage. After staking the box in place, fill it within an inch or two of the top with alternate layers of dirt and gravel, well tamped. Sprinkle it, tamp again, and, if possible, let it settle for a month or more so that when the cement is poured, the surface will not crack.

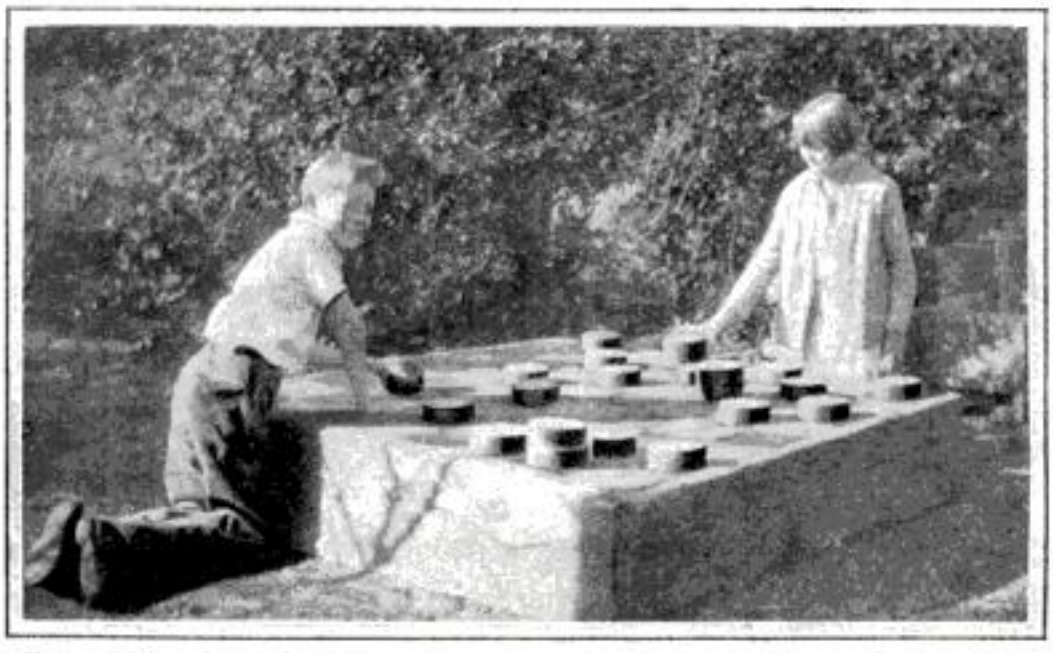
The remainder of the box is filled with concrete composed of three parts sand, one part Portland cement, and enough water to give a workable consistency. With a mason's trowel, smooth the entire surface, leaving it rather moist so that it will take the coloring well. The squares cannot be colored, however, until the concrete has partially hardened.

While waiting for the concrete to set, drive nails along the four sides of the form, beginning 2 in. from each inside corner and spacing them 7 in. apart. Stretch strings across the concrete from nail to nail to divide the surface into sixty-four 7-in. squares with a 2-in. border all around the large concrete checkerboard.

From an old magazine cut thirty-two 7-in. squares and dip them in a pail of water. Place these paper squares on every other square of the checkerboard, being careful that the edges adhere to the wet cement. When this is done, the checkerboard is ready for coloring.

The best material to use is regular red cement coloring in powdered form. Sprinkle it over the concrete and smooth it out with the trowel. It mixes with the moist cement in such a way that it will not peel off. The strings and squares of paper are now removed, leaving every other square white. The wooden form may be left in place and painted red or any other color that will harmonize with the garden furniture.

The checkers should be about 5½ in. in diameter; they may be turned on a lathe or ordered at a woodworking mill. If you play chess as well as checkers, you may also wish to make a set of chessmen, which is not difficult if you have access to a lathe.



You can give the ancient game of checkers new popularity among your friends by building a concrete checkerboard in the garden where they can play in the open.

Here's one of the simplest ship models you can construct—

A Graceful Venetian Gondola

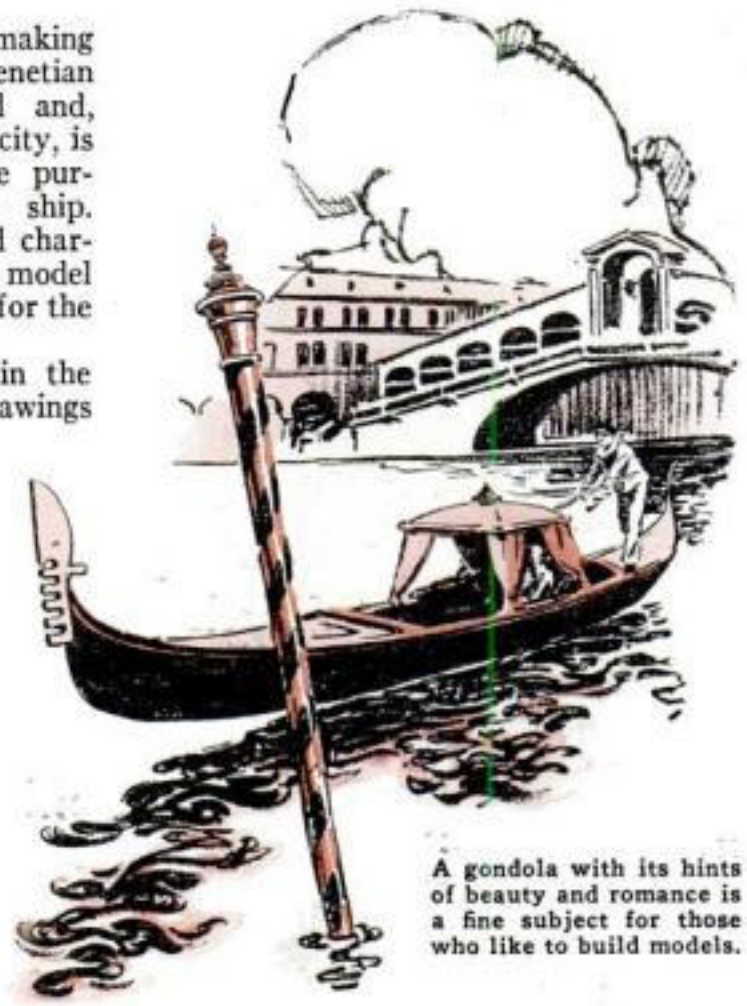
UNLIKE many ship model making projects, a model of a Venetian gondola is easy to build and, because of its small size and simplicity, is better suited for some decorative purposes than a larger full-rigged ship. Indeed, with its graceful shape and characteristic ornamentations, a gondola model forms an unusual and artistic piece for the mantel, radio, or bookshelf.

The 11½-in. model illustrated in the accompanying photographs and drawings is the remarkable work of twelve-year-old Lloyd Halpenny, of Haringen, Texas. He not only built the model unaided, but he did his own research and made his own working drawings.

While Lloyd designed his model after the modern gondola, which by law must be black, a more decorative model can be made by fashioning it along the lines of the early eleventh century gondola, which was often brightly colored and gorgeously decorated with gold trim and brilliant silks. It was undoubtedly because too many private gondolas were painted to look like the boats of wealthy officials that the law was passed prohibiting all colors but black.

A 1¾ by 2¾ by 12 in. piece of white pine is used for the hull. Cut it out roughly first with a saw, and do the final shaping with a sharp knife and a plane. Cardboard templates made from the body plan will help you obtain the correct shape at each of the six station points.

The inside of the hull should be gouged out, and the steps at the forward end may be carved in place or made separately and glued in position.



A gondola with its hints of beauty and romance is a fine subject for those who like to build models.

Plywood, ¼ in. thick, is used for the ornamental bow and stern pieces. These can be cut out with a jig saw and glued in grooves cut in the hull.

The sides, front, and back of the low cabin or "felze" are cut from stiff cardboard, while the dome-shaped top is carved from a block of pine. In assembling the cabin, strips of cloth can be used on the inside to reënforce the corner joints, and cloth will also serve as a hinge for the door.

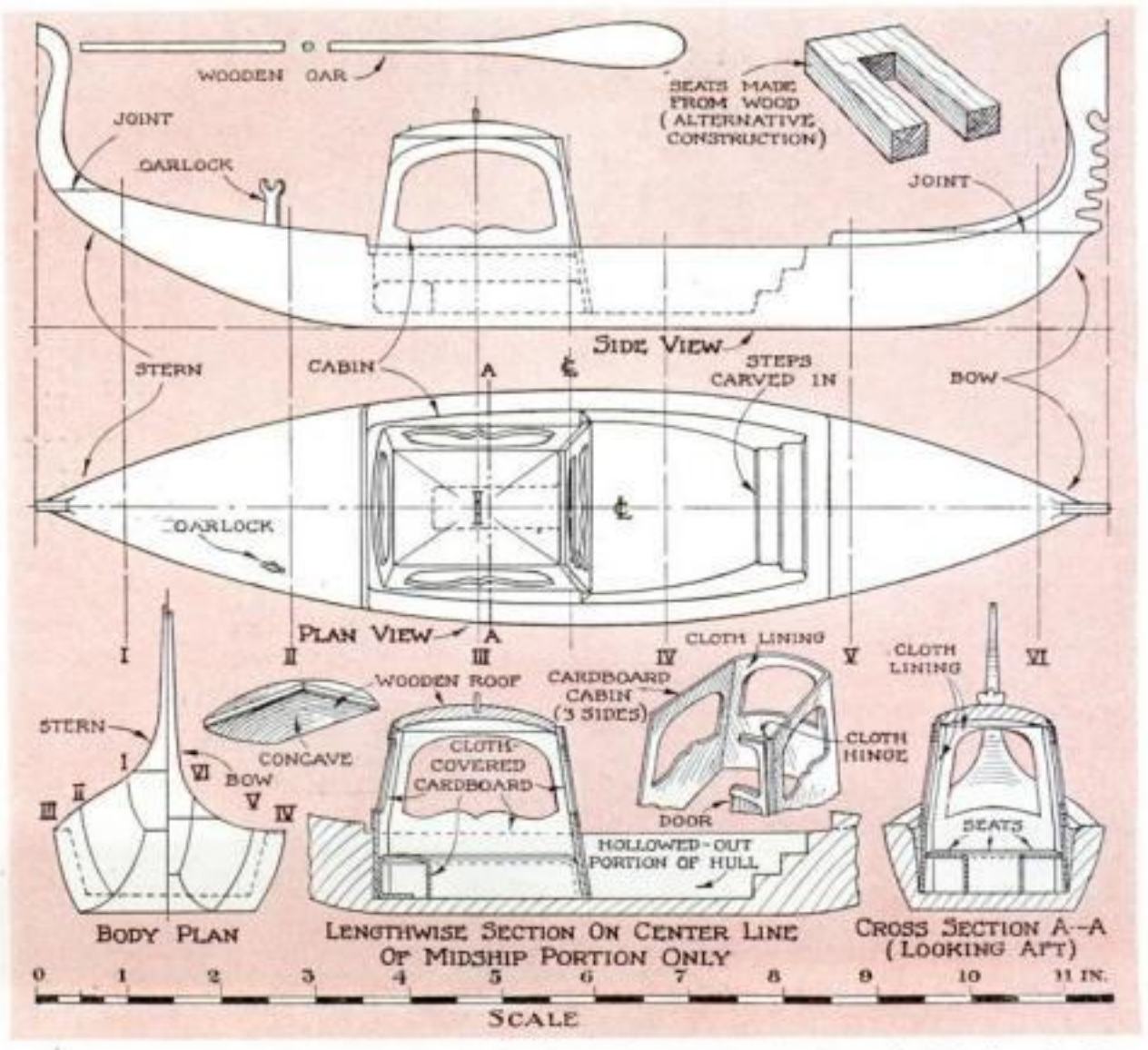
At this point cover the inside of the cabin with silk of brilliant hue. Before the cabin is placed, it will also be necessary to make and cover the little seat which goes at the after end of the cabin. This can be carved from a block of softwood, padded with cotton, and covered with a piece of the same silk used for the inside of the cabin. A scrap of velvet glued on the floor of the cabin will simulate a rug.

Stiff cardboard or metal can be used for the oarlock, which is glued in a hole 1-in. abaft the after end of the cabin.

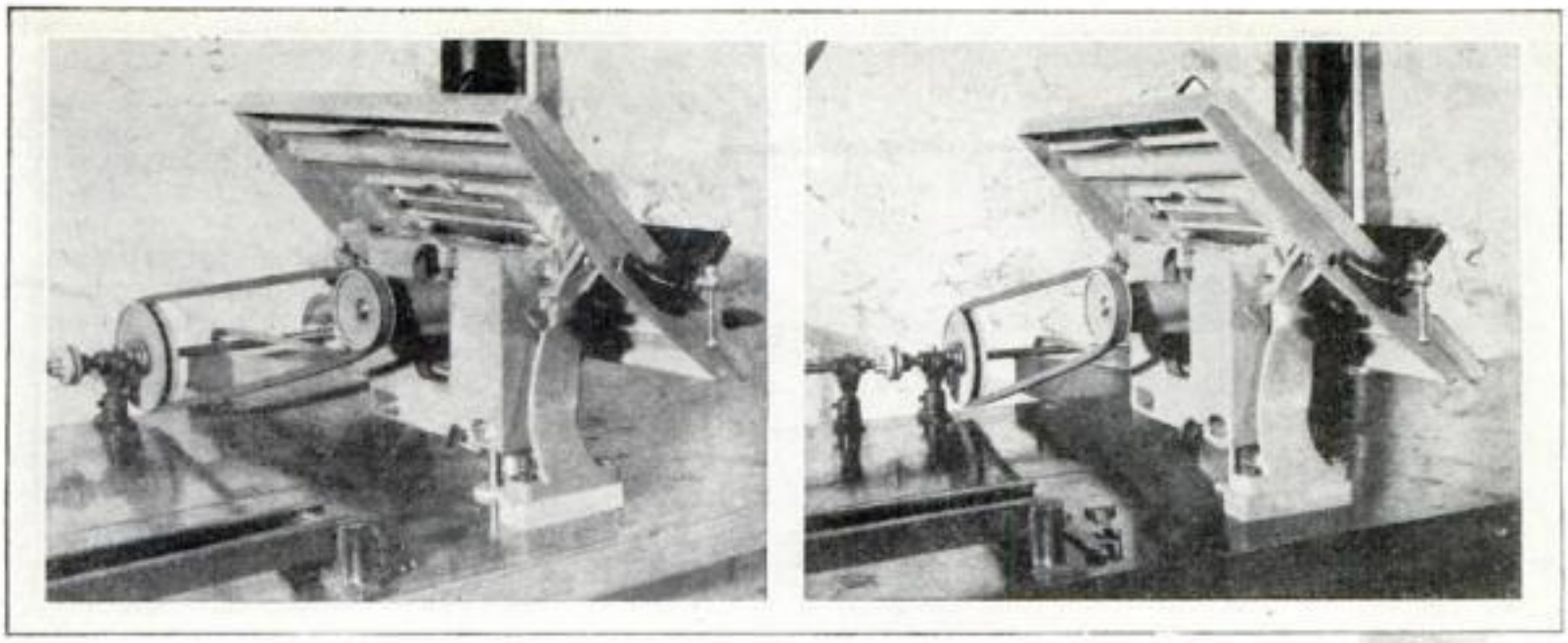
The coloring of the model is largely a matter of personal choice. If the model is of a modern gondola, the entire hull, of course, must be black; but if the older type is being modeled, the use of color is without limitation.

By visiting museums and libraries, you can obtain some idea of the favored colors. There were, however, no set color schemes; each family painted its gondolas in the manner that seemed most attractive.

Lloyd Halpenny with the model he constructed.



Side and plan views of the gondola model; a body plan showing the shape of the hull at the six station points; two sectional views; and detail sketches of the cabin, seats, and 6½-in. oar.



Which is the better photo? One was taken with an expensive professional outfit while the other was taken with a small folding camera. As explained in the text, the difference is slight in certain instances.

Picking a Camera to Suit Your Needs

By FREDERICK D. RYDER, JR.

MANY people think that the more you spend for a camera, the better will be the picture that you can take with it. This idea is wrong. The essential difference between a low priced and a high priced camera lies in the photographic limitations of the two instruments. The simple outfit can take good photographs only when conditions are just right, but the more expensive cameras can take good pictures under all sorts of difficulties.

At the bottom of the price scale are the simple box cameras that sell for a dollar or two. While these cameras represent great value for the money, photographically speaking, their possibilities are strictly limited to outdoor snapshots of stationary objects in the bright sunlight or to relatively long time exposures indoors. Also, because of the single lenses used in such cameras, only a fair degree of detail can be expected.

The next step up in camera equipment is the simple folding instrument fitted with what is known as a rapid rectilinear lens—a double lens giving much sharper pictures—and a focusing scale so that the lens can be adjusted for near or distant objects. This type can be bought for from six to fifteen dollars depending on size and style. A camera of at least this grade is necessary if you are going to make a serious attempt at photography. It will take clear snapshots in bright sunlight or even when the sky is a bit cloudy; it will make indoor time exposure pictures of people in half the time required by the dollar box cameras; and with the lens stopped down it will make fine, sharp photographs of still objects either indoors or outdoors.

If, for example, you take a snap of the youngster or of something you have built in your home workshop with such a camera and the result is a failure, blame yourself; the chances are about one hundred to one that it is your fault.

Study the two test pictures shown side by side at the top of this page. One was taken with a small 2¼ by 3¼ roll film folding camera of the class just mentioned, and the other was taken with a 5 by 7 in. professional type view camera that cost complete over two hundred dollars. The picture at the right was taken with the small camera. As time was not an important factor, the smallest opening in the lens of each camera was used in taking each picture, and with the small opening there is, as the test pictures prove, no practical difference in sharpness.

I think you will agree that such results amply demonstrate the possibilities of a simple, inexpensive camera. However, I do not wish to give the impression that an expensive, high-grade camera is not worth while. The additional lens speed and more elaborate adjustments are very valuable—but only when you know how to use them.

In taking the photographs shown above, the cameras were set up one beside the other.

The secret of taking good pictures with an inexpensive camera is, first, to obtain the proper lighting (see P.S.M., June '31, p. 83); second, to use the smallest stop in the lens (this means move the little lever until the hole that lets the light through the lens is as small as possible); and third, to make a correspondingly long time exposure. Obviously, a tripod or some other equally firm support must be used. One of the golden rules of photography, indeed, is to use a tripod, a small stop, and a long exposure on any picture that does not include people, animals, or moving objects.

The one disadvantage of the small size picture is that the tiny prints are not very impressive. However, if they are well taken, they can be enlarged. The test picture taken with the 2¼ by 3¼ in. camera, when enlarged to 8 by 10 in., could easily pass for a photograph taken with an 8 by 10 in. camera. On the other hand a camera taking a larger picture costs more to buy and a lot more to operate because of the increased cost of film, development, and printing. Of course, the advantages of light weight and compactness also are in favor of the small camera, as far as the amateur is concerned.

The next step up in cameras is the outfit already described fitted with an anas-

$10 Prize for the Best Photograph

POPULAR SCIENCE MONTHLY *will pay $10 for the most photographically perfect picture of a piece of machinery submitted on or before August 1, 1931. It may be of anything from a carpet sweeper to a steam locomotive, but must be taken by an amateur during the months of June or July, 1931. Any type of camera may be used, and the development and printing may be done by the contestant or by a professional. Mail entries in care of the Photographic Editor postmarked not later than August 1, 1931. None will be returned.*

tigmatic lens. Such lenses give much sharper pictures in snapshots where it is necessary to use a large stop or opening to get enough light for an adequate exposure. It is now possible to obtain cameras in the smaller sizes with genuine anastigmatic lenses at less than twenty dollars. These lower priced high-grade lenses are only a trifle faster than the rectilinear lenses, but they give much sharper, clearer pictures when used with the larger stops.

At considerably higher prices, from thirty to forty dollars and up, it is possible to obtain faster anastigmatic lenses, which, because they permit the use of a larger opening, cut the exposure time accordingly. These faster anastigmats are no better than the cheaper, slower types of anastigmats for pictures of still objects such as the test picture on page 83. Their advantage is in being able to take snapshots in very poor light or pictures of the baby, for example, where a short exposure is a big advantage. These faster lenses on folding cameras are usually fitted in shutters capable of snapshots of about a two hundredth of a second.

If you want real speed pictures of any type of athletic event, you must use a camera fitted with a fast lens and a focal plane shutter—a spring-driven curtain with a slot in it which slides past close to the film. This shutter will make exposures of one thousandth of a second. The most convenient outfit embodying these features is the reflecting mirror, graflex type.

A Cigarette Box That Mystifies

By KENNETH MURRAY

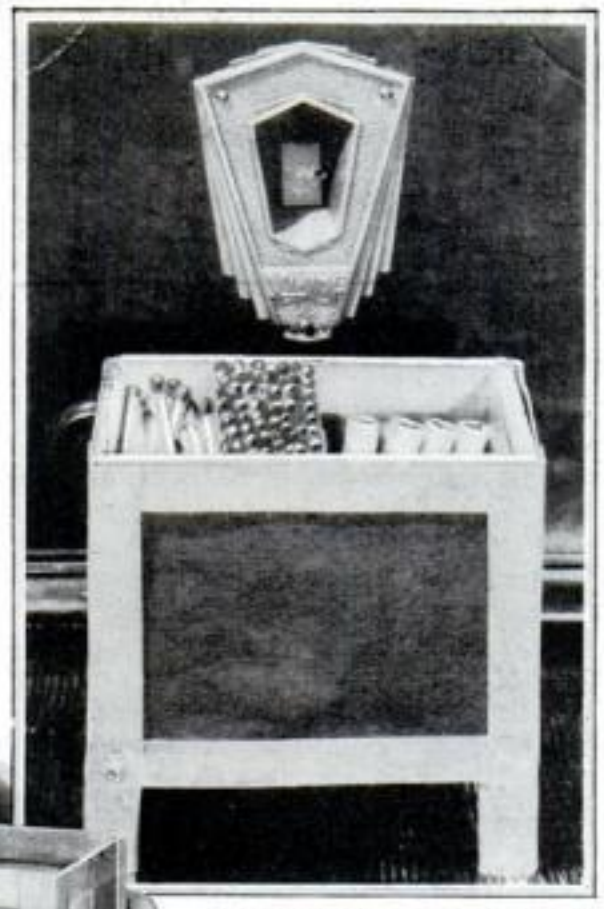
THIS tricky cigarette box is always empty—except when its owner wants to smoke. Then, quite like magic, it suddenly is seen to be well filled with cigarettes. And what an advantage that is for anyone who has too many cigarette borrowing friends!

To construct this mystifying container, you will need a deep cigar box, which should be cut down to a smaller box with inside measurements of 3½ in. deep, 4 in. long, and 2¾ in. wide. Make a frame of metal strips as shown to hold this box loosely 1 in. off the table. Suitable metals are nickel plated zinc, which has a high polish like silver, or monel metal, but you may use whatever you please.

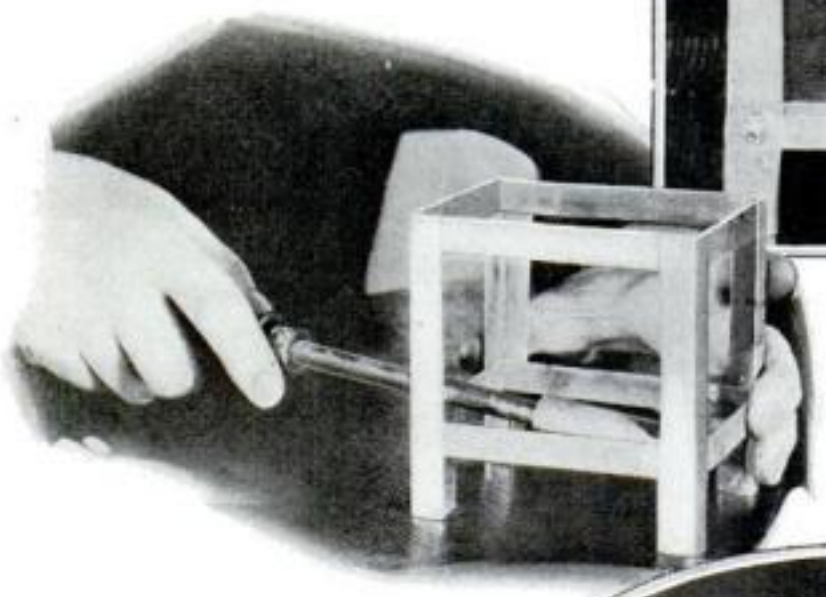
The drawing shows how to arrange the interior of the box. A U-shaped sheet of the same metal as that used for the frame is made to fit into one half of the box in such a way that it slides freely from one side to the other when the box is tilted slightly. It is in this that the cigarettes are later placed. One half of the box at the top is then filled with a shallow match tray. This is divided into two parts, and a number of match heads are glued in one compartment as shown to give the tray a deceptive appearance of depth.

When the U-shaped piece is filled with cigarettes and the box is tilted, the entire cigarette container, except for one edge, slides out of sight beneath the match tray. This gives the box the appearance of being empty; and the chance of detection is further lessened by attaching a piece of the same kind of metal to the end of the box inside.

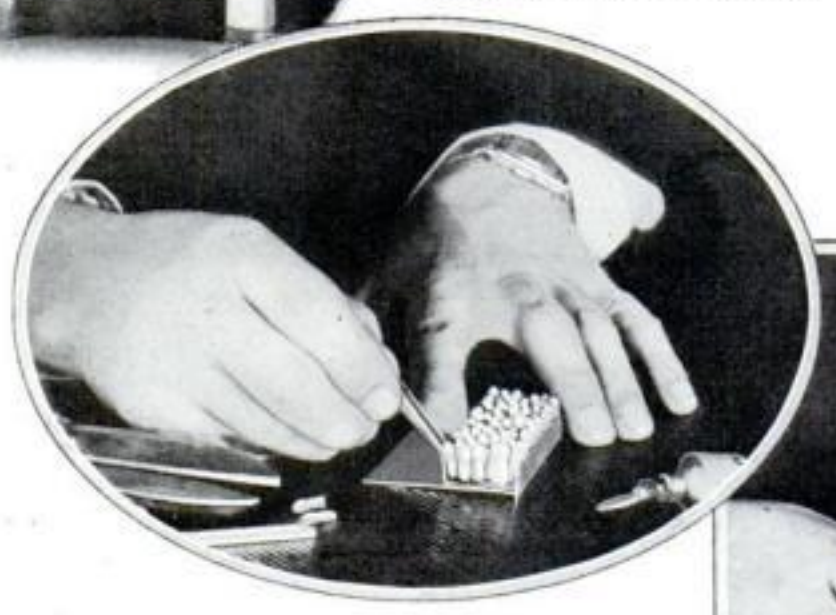
Cover the wooden box on the outside with real or imitation leather before placing it in the metal frame, and add a lid if you wish, although it is not necessary.



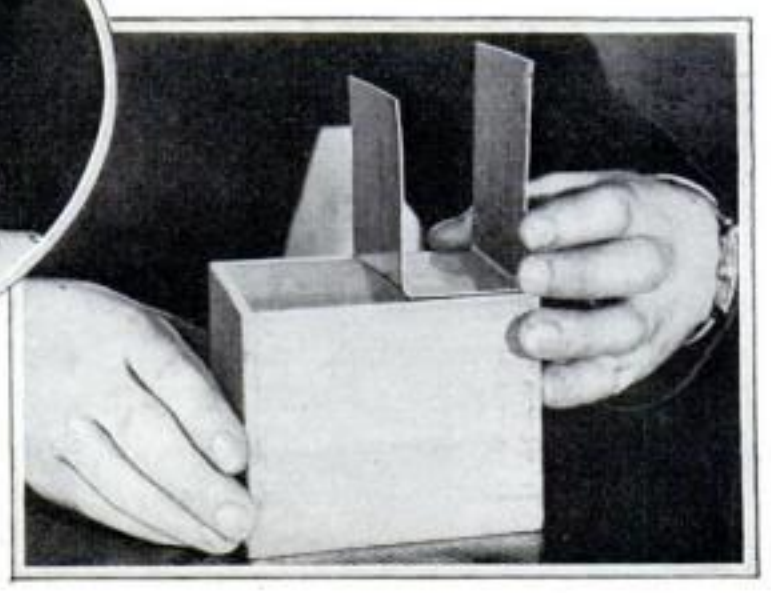
Merely by the way in which he picks it up, the owner of this box can cause the cigarettes to vanish or reappear.



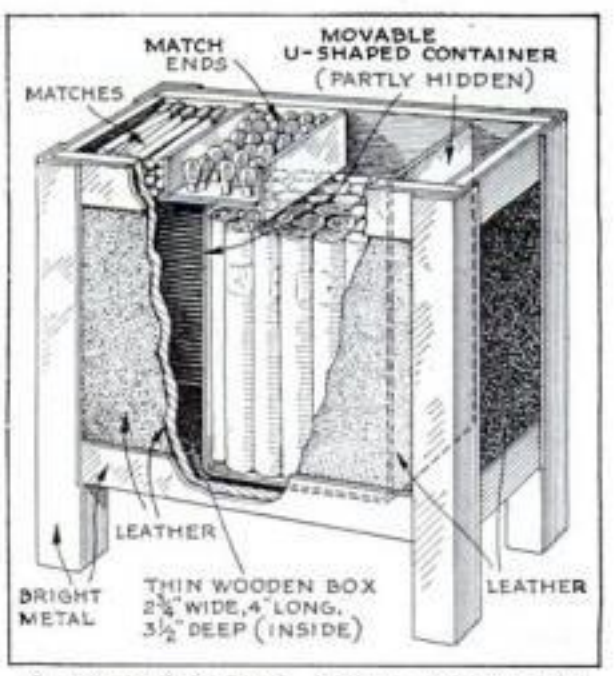
Left: The nickel plated zinc or monel metal strips for the frame are soldered together.



Match heads are glued in the fake match compartment to give an appearance of greater depth.



Right: The movable holder for the cigarettes is made of metal. The real and fake match trays are placed flush with the top edge of the box.



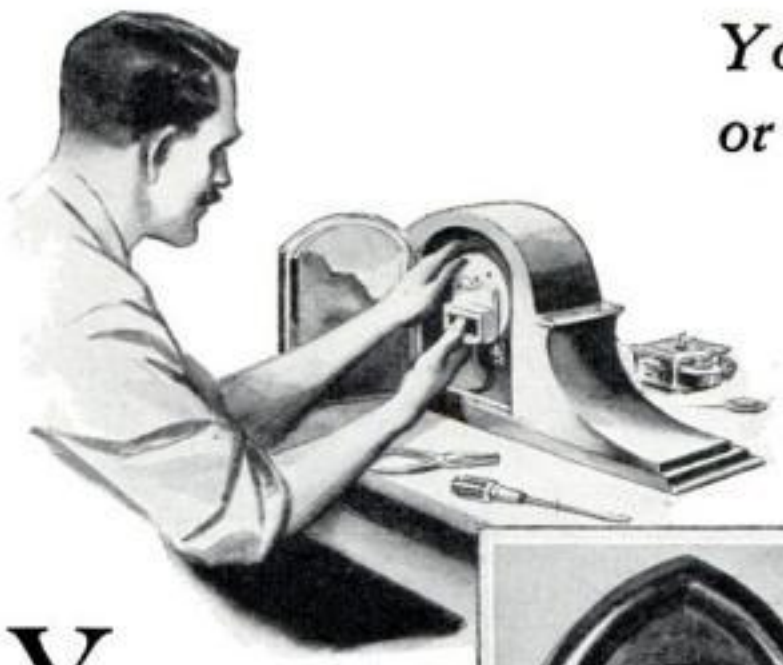
A perspective sketch, broken away to show how this novel cigarette box is assembled.

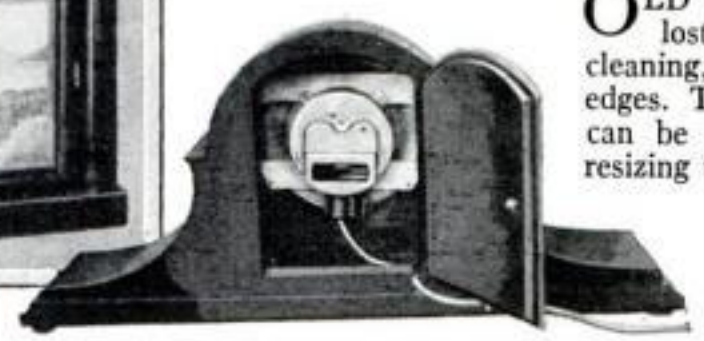
A WHITEWASH more durable than the average, especially for outdoor use, can be made by mixing 1 part of linseed oil with every 16 parts of whitewash as soon as the lime is slaked.

It's Easy to Electrify a Clock

You can put the movement in an old case or build one designed especially for it

By EVERETT EAMES





At right: An old case with an electric movement installed in place of the spring-operated works. *At left:* A clock case made as shown below.

YOU may be well aware of the convenience and accuracy of the new electric clocks and still hesitate to buy one to replace an old, faithful, and beautifully designed mantel clock. There is, however, no need to discard the old clock. An electric movement driven by a tiny synchronous motor can be installed in place of the spring-operated works without difficulty.

A suitable electric unit may be obtained through electrical dealers or jewelers or removed from a low priced electric kitchen clock. Remove the works from the old clock by loosening the several screws and wood blocks that hold it in place, and take off the metal rim and the face. Cut two 1 in. wide strips of 1/32 in. thick soft copper, and after drilling two holes for mounting, solder them to the lugs on the electric unit as illustrated. Soft copper is used so that when the unit has been mounted as accurately as possible, it can be centered exactly by bending it slightly.

Fasten the strips with short roundhead screws which will not pierce the front of the case. Replace the face, attach the hands and electric cord, and the clock is ready to run. Cut a notch for the cord in the back of the case under the door.

If one wishes to make his own clock case, the design shown at the right is simple and attractive. This case is entirely of wood, and the dial is drawn on cardboard with compass and ruling pen. Should mahogany or walnut be too expensive, basswood or whitewood may be used and stained mahogany or walnut color.

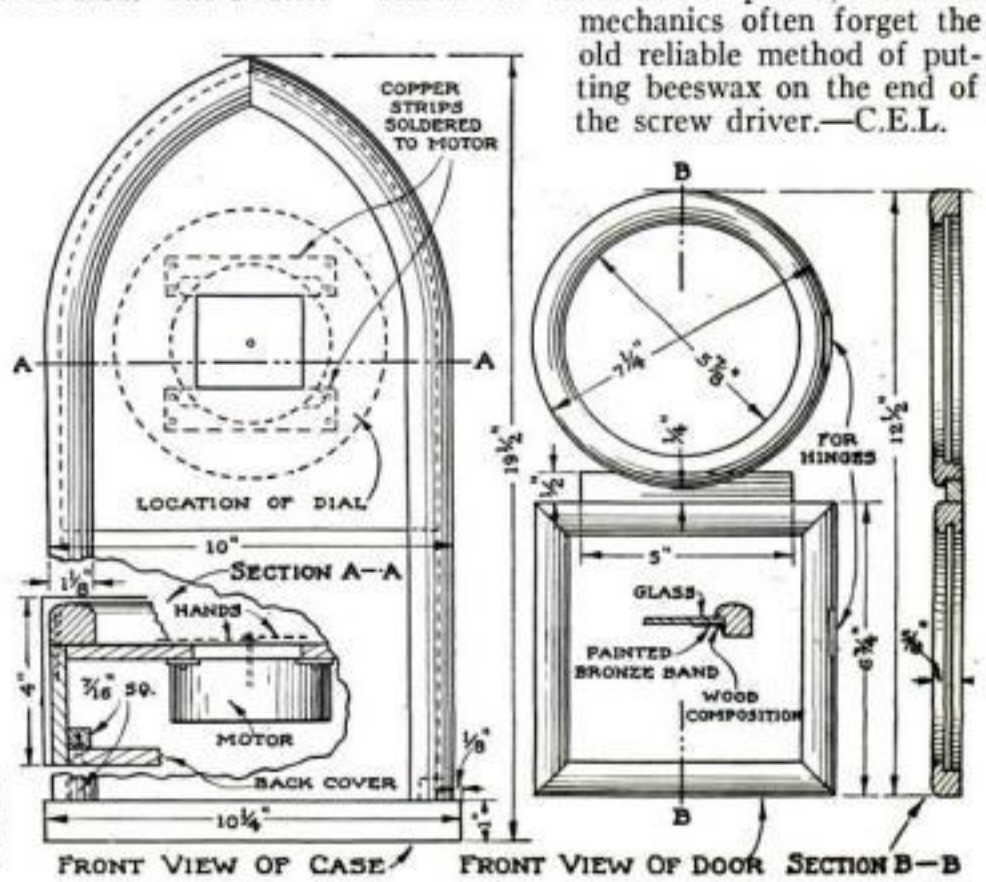
The sides are 5/16 in. thick and 3 in. wide. Prepare them for bending by making a series of saw cuts in them as shown in the photograph. Then shape a block to serve as a form. Place one side strip in hot water for five minutes and bind it to the block with friction tape. Allow it to dry on the block in a warm place for several days; then shape the other piece. The curved front molding may be bent in the same way, but it is easier to cut it directly from a board and smooth it with spokeshave, cabinet files, and coarse and fine sandpaper.

The circular part of the door may be turned on a lathe faceplate or sawed carefully with a fret saw or jig saw. The recess for the glass can be cut with a sharp knife if the latter method is used. The glass in the two sections of the door is held with a paste wood preparation, and the three pieces making up the door are glued with hot glue and clamped.

Assemble the case with hot glue and countersunk brads. Sandpaper thoroughly and stain. When dry, brush with three coats of white shellac into which has been stirred enough stain to color the mixture thoroughly. Sand lightly between each coat. This will give a finish which may be waxed to resemble mahogany or walnut almost perfectly, even if a cheaper wood has been used. The electric unit is mounted as previously described.

The picture placed in the lower part of the glass door should have some blue in it to give a pleasing contrast to the wood tones. A brass knob and a band of bronze paint carefully applied around the edge of the glass inside the door will give a finishing touch.

NOTE: Before buying the electric movement, find out if your lighting company supplies 100-130 volt, 60-cycle alternating current and maintains a time service.



Drawings of a simple homemade case, and photo showing how sidepieces are bent.

GLUE SIZE LENGTHENS LIFE OF OLD RUGS

OLD rugs, especially those which have lost the sizing on the back through cleaning, have a tendency to roll up at the edges. This can be corrected and the rugs can be made to wear much longer by resizing them in the following manner:

Spread the rugs face down on the floor of the attic or any suitable surface and tack them at frequent intervals. Then sprinkle them or brush them with a size made as follows: Soak 1 lb. of ground carpet sizing glue in about 6 qt. of cold water for two or three hours, add about 3 qt. of boiling water, and stir until the glue is fully dissolved. Do not, of course, apply so much glue to a lightweight rug that it will penetrate to the face side. Allow the rugs to dry twenty-four hours.

IN TRYING various trick ways to start screws in inaccessible places, amateur mechanics often forget the old reliable method of putting beeswax on the end of the screw driver.—C.E.L.

By J. G. PRATT

Bow Making

Simplified for Beginners

Fig. 1. Mr. Pratt, former president of the Potomac Archers, shows how the bow is held.

If there is one sport that has been developed through the centuries for the special enjoyment of the home workshop enthusiast, it is archery. Unlike golf, tennis, and so many other sports, archery gives you the opportunity to make your own equipment. And there is something of peculiar fascination about shaping a bow. It is so graceful and powerful and becomes so much a part of the archer that it seems to take on almost human qualities.

ARCHERY, the oldest and most romantic of outdoor sports, is coming back into its own. It should appeal particularly to those who have home workshops, because fully half the fun is to make your own equipment. In this article and one to follow will be given simple and concise suggestions as to the easiest way to go about making high-grade target bows and arrows.

To save yourself unnecessary work and the many difficulties caused by attempting to use poor materials, you should purchase one or two bow staves from a dealer. These are usually about 1⅛ in. square and 6 ft. long. The best material for the beginner is lemonwood, costing about $1.50 a stave. This wood is easy to work into an excellent bow. Yew and osage orange give a slightly better cast, but they have a tricky grain and should be left until you are more experienced.

It is customary to make a man's bow 6 ft. long. If 2 or 3 in. shorter, a bow has a snappier cast but is more likely to break. A good plan is to make it full length, and later, when you have "grown up to it," you can increase the pull several pounds by cutting off 2 or 3 in.

To mark the position of the handle, draw two lines around the stave, one 1 in. above and the other 3 in. below the center, as shown at *A* in Fig. 6. Draw a line down the center on two sides as at *B-B* (selecting the sides which have a curve or warp, if any). At each end make marks 5/16 in. from this line as indicated at *C*, and draw lines from each of these to the extremities of the handle lines, as at *D*. Use a sharp hatchet (Fig. 2) for removing the surplus wood (indicated by the tinted areas in the drawing of the back view), and plane to the line.

Decide which is to be the back of the bow and carry the lines marked *E* from the four upper corners *F* of the handle to points ⅝ in. from the back of the bow at the ends. Trim to these lines as before.

The stave now has a square taper towards both ends. Keep the back flat. Beginning at the handle, give a curved dip to the belly as shown in the detail marked *G*. This curve sinks in about ¼ in. at a point 5 or 6 in. from the handle; from this point the belly is given a straight taper to the ends. Now round the belly with spokeshave and plane. These tools are to be preferred to a drawknife, which might cut too deep and ruin the bow. Test frequently to see that both ends bend alike. Instead of the usual half-round, I prefer bows shaped more like a Gothic arch (see the cross sections at *H*).

When the stave is practically down to the proper size, cut nocks (the archer's term for notches) at the ends as shown at *J* with a small rat-tail file or sandpaper rolled on a nail. String up the bow temporarily with a thin clothesline or any very strong cord. You will probably need help to do this. Have the string of such a length that it stands away from the grip about 6 in.

Fig. 2. The stave is first roughly chopped to a tapered shape.

With the bow thus strung, it is an easy matter to scrape it down with broken glass or a cabinet scraper and rub it with coarse sandpaper until both limbs curve uniformly when the bow is full drawn. Continue scraping until the pull (or "weight," as an archer calls it) is what you desire. The pull will drop a couple of pounds after the bow has been in actual use for some time.

The grip is finished by rounding out the back about ⅛ in. with an added piece of wood, and another small block is glued to the lower portion of the front of the grip so that it will fit snugly into the palm of your hand, as at *K*. When these have been glued on and rounded nicely, wrap the entire grip with cord, fastening it with glue and finishing the ends with ¾ in. wide strips of leather.

Spare no pains in giving the bow a perfect finish. Use a roll of sandpaper for removing imperfections. Apply spar varnish, allow it to dry at least three days, and rub it down with linseed oil or rubbing oil and pumice stone on a soft rag. Clean off thoroughly and varnish again, and repeat the procedure two or three times more, if necessary. If you wish, you may purchase horn nocks like those on the bow shown at *L* to take the place of the plain grooves in the wood, but these add nothing to the bow's efficiency.

To find the pull in pounds, use an ordinary spring scale of sufficient capacity and pull the string out 28 in. from the grip. A convenient way to do this is shown in Fig. 5. While not essential, a knowledge of the exact pull will help you in making a bowstring that is neither too light nor too heavy for your bow.

The process of making the string is difficult to describe but easy enough to carry out after you have learned the principle and done a little practicing. Of course, you may buy your string, if you prefer.

To make your own string, obtain a ball of Irish flax No. 12 (linen thread), some carpet thread, a cake of yellow beeswax, and a little rosin. Melt 2 oz. of beeswax and 1 oz. of rosin and work the mixture into a ball as it cools.

Drive two small nails into your workbench or any suitable support at a distance apart equal to 9 in. more than the

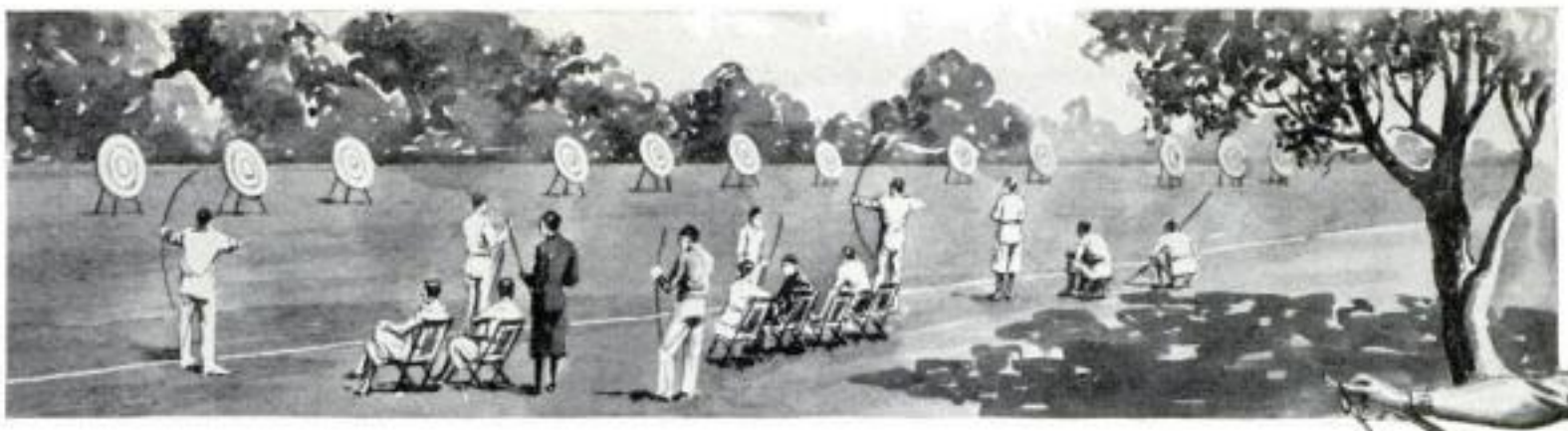


Fig. 3. The rapidly growing popularity of archery has led to the formation of active clubs in many sections of the country.

Fig. 4. How a bow is held while it is being strung up, or in the language of an archer, "braced."

length of your bow. The string should contain one thread of flax for each pound the bow pulls, and it is made in three strands. If it pulls 45 lb., for example, wind the flax around the nails until you have a strand of 15 threads, and wax it into one cord up to within 8 in. of each end, keeping it taut and free from kinks. Now give each end of the strand a tapering effect by cutting off two threads at a point 1 in. from each end, two more threads at 2 in., two more at 3 in., and so on, as shown at *A*, Fig. 7. Wax the ends thoroughly, lay the strand aside, and make two more like it.

To strengthen the ends, prepare six strands about 10 in. long, each consisting of about 12 threads each. Wax them and taper or stagger the ends. Place one short strand at the end of each of the long ones, and wax them together.

You now have three long strands, each thickened at both ends. Bring the three together and grasp them in the left hand about 4 or 5 in. from one end, or at about the center of the thickened portion. Twist them tightly at this point for a distance of about 2½ in. (see *B*, Fig. 7). The method of doing this is to twist the outermost strand away from you with your thumb and forefinger and then bring it toward you over the other strands; then twist the strand which is now outermost and bring it over the other two; and continue in this way, the idea being to twist individual strands in one direction and at the same time twist the three main strands in the opposite direction.

When you have twisted sufficient string to form a loop about 1¼ in. long, fasten the loop temporarily with a bit of thread. Now place the loop over a nail and wax each short end into one of the long strands, as at *C*. Proceed to make rope by the method just described. Pull hard and wax continually. The other end of the string needs no loop, but it will have a smoothly tapered extra thickness caused by the three thickening strands.

Place the loop over the upper nock of the bow. Then, about 4 in. from the lower nock, wind the string around the bow in a timber hitch, made as shown at *D*, Fig. 7. To string the bow for shooting, let the loop slide down the upper limb and slip the timber hitch down to the lower nock and draw it tight. Grasp the handle with the left hand with the string down. Place the lower end of the bow against the instep of the left foot, and pressing down on the upper limb of the bow with the palm of the right hand, fingers extended, slide the loop into the nock as shown in Fig. 4. If it seems easier, you may reverse the position, left to right. The string can be tightened, if necessary, by releasing it and twisting the timber hitch end a few times. How the full drawn bow is held is shown in Fig. 1.

When the bow has been strung up, wrap 3 or 4 in. of the center of the string with waxed carpet thread to protect it against wear. The string should bind slightly in the arrow nock, but this adjustment can be made later by winding that part of the string with silk. Fasten a string or ribbon from the loop to the upper end of the bow (a hole can be drilled for this) to keep the string from slipping down too far when the bow is unstrung. The bow should be left unstrung when not in use. Leaving a bow with a tight string will give it a permanent bend and decrease its efficiency. For the same reason, do not stand a bow on one end; hang it on a nail by its own string.

The making of arrows and other tackle will be described in the August issue.

If you wish a list of books on archery and dealers in archery supplies, send a self-addressed and stamped envelope to the Home Workshop Department.

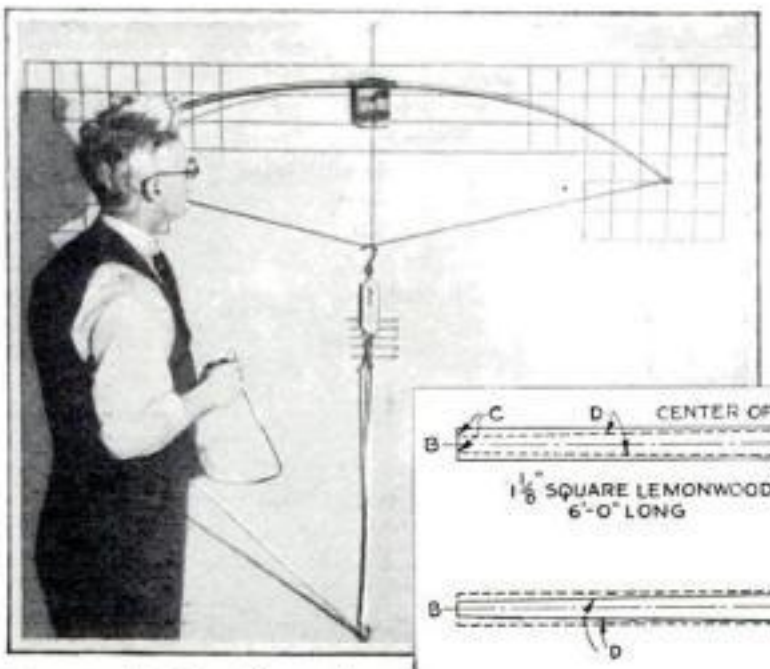


Fig. 5. Testing the pull.

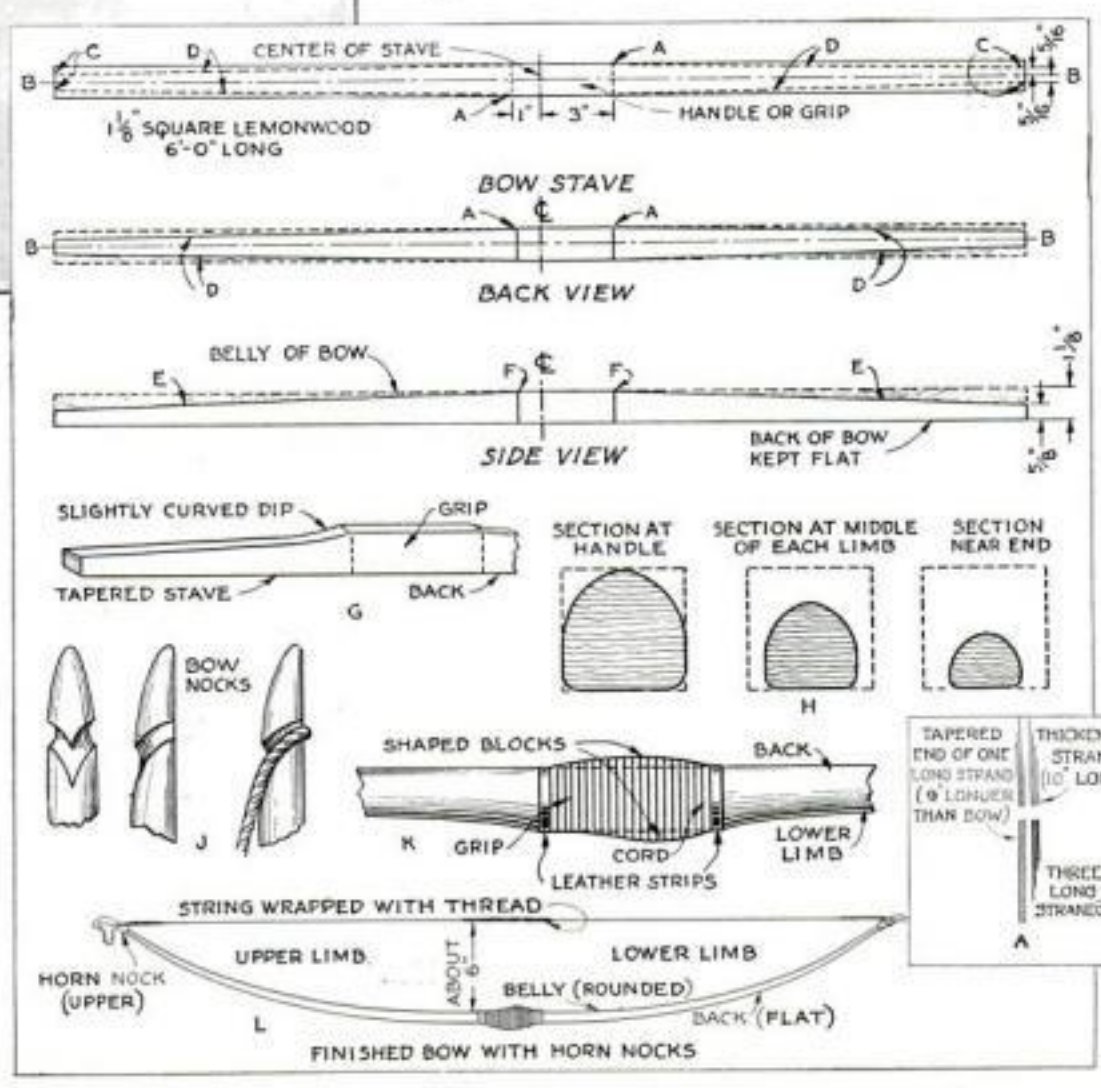


Fig. 6. *(at right).* Steps in constructing the bow.

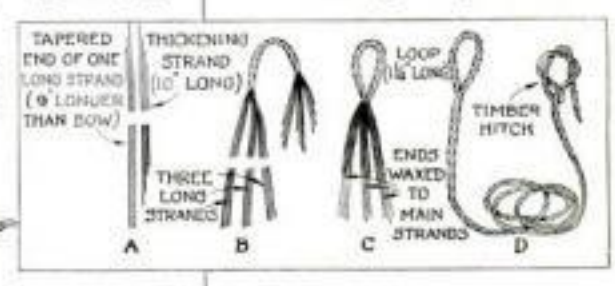


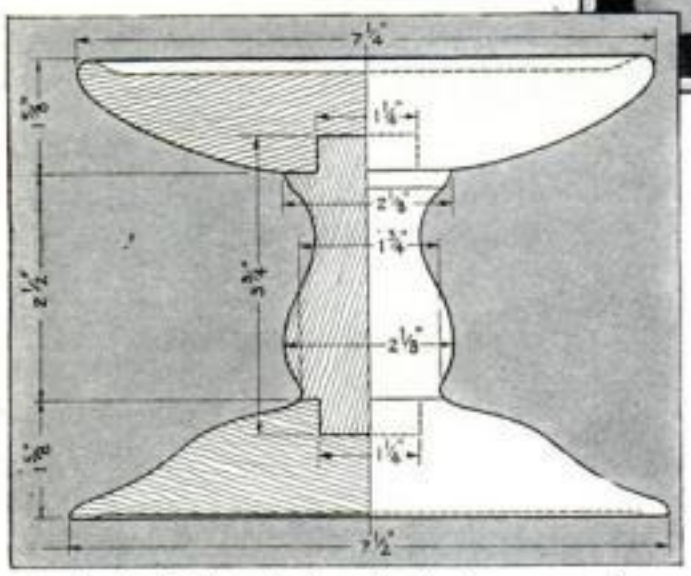
Fig. 7. Method of twisting a strong, durable bowstring from waxed linen threads.

TURNED WALNUT BASE HOLDS FISH BOWL

THIS decorative fish bowl support serves the double purpose of protecting the table from the moisture and raising the aquarium so that it can be seen to better advantage.

The top and bottom were made from two pieces of walnut 1⅝ in. thick and 7½ in. square, and the short upright from a piece 2¼ in. square and 3¾ in. long. Instead of finishing the pieces individually, the top and bottom were first merely turned round and bored. Then the upright was set between centers and provided with accurately turned tenons or dowels. The parts next were assembled with high-grade glue and, when the joints were thoroughly dry, were turned to the desired shape. In this way it was possible to work the glued-up joints into the design and make it appear as a single piece of stock.

The finish consisted of a light application of walnut stain and three coats of clear lacquer applied while the piece was turning. A piece of green felt was glued to the bottom.—D. R. V. H.



A stand of this size is suitable for any ordinary type of round glass aquarium holding about 3 gal.

Placed on a well-designed wooden base, this plain fish bowl takes on new beauty.

INNER TUBE WRAPPING KEEPS PUTTY SOFT

Left-over putty will remain usable if it is tightly bound in a piece of old inner tube.

RARELY does one use all the putty obtained for any given job. The ball left over is usually wrapped in paper which soon absorbs most of the oil; then the oil gets over everything else, and the putty becomes as hard as a brick. A better way is to put the ball in a piece of old inner tubing, leaving 3 or 4 in. extra on each side to fold over. Hold the covering with bands cut from the same tube. Putty so protected keeps for months.—FRANK W. BENTLEY, JR.

BACK YARD WADING POOL GIVES CHILDREN JOY

THERE is no more engrossing piece of summer equipment for the home playground than a wading pool, where youngsters can paddle, sail boats, and have the endless diversion that water gives. The one illustrated below was made by Robert Laveaga, a Californian, for $1.75—plus, of course, his own labor.

Instead of being an excavation, the pool has a raised rim 1 ft. high. The ground was made level, pounded hard with the back of a spade, the center determined, and a circle drawn 9 ft. in diameter. The rim was built of field stones and cement mortar mixed in the proportion of 4 parts sand to 1 part cement. No form was used. On the outside, the rim was left rough; inside, it was smoothed with cement.

The drain, made of 1½-in. pipe fitted with an elbow and a plug, was placed near the rim, at the lowest part of the surface. The pipe was slipped under the rim a few inches below the surface and held in a furrow, which ended in the garden at a 6-in. lower level. Then the flooring was put in—3 in. of the same cement mixture laid directly on the earth—and left two days to harden. A grouting of pure cement and water was then applied with a brush.

Around the pool Mr. Laveaga put a 2 ft. wide band of clear sand, divided from the lawn by a rim of stones and cement.—FRANCES DUNCAN.

OUTBOARD MOTOR CART

A BABY buggy chassis salvaged from the junk heap can be converted into a convenient cart like that illustrated above for hauling an outboard motor to the water front. It will also hold oars and fishing equipment.—GEORGE CHATTERTON.

This 9-ft. pool consists of a smooth concrete floor and a rim of common field stones laid up in cement mortar.

CONVENIENT LETTER BOX BUILT IN PORCH POST

WHEN a front porch has square, hollow wooden columns of the ordinary type, it is possible to construct a built-in letter box in one of them as shown above. A box of this kind is especially convenient if the porch is screened in during the summer, because it allows the letter carrier to put the mail in from the outside and the residents to remove it from the inside. The porch post illustrated has still another use. Being of ample size, it serves during the winter months as a convenient storage place for fans and fly swatters.—LOUIS S. WARNER.

NAMES and notations written in pencil on wooden plant labels will remain legible almost indefinitely if protected with a coating of transparent waterproof household cement of the type sold in tubes.

What Can You Make *from* These Materials *A New Prize Contest*?

HERE is a new and novel contest that is a direct challenge to your home workshop ingenuity. POPULAR SCIENCE MONTHLY will give $100 in cash prizes for the six most interesting, ingenious, and original articles made from the following materials or any part of them:

1 pc. ⅞ by 8 by 18 in. white pine or other softwood
1 pc. ¼ by 6 by 12 in. wood of any kind
3 wooden dowel rods ⅜ in. in diameter and each 3 ft. long
1 pc. sheet metal 4 by 10 in. of any kind
1 pc. wire 24 in. long and of any gage and kind

In addition you may use whatever glue, nails, screws, thread, string, or other materials you need for securing the joints or for minor accessory purposes, but these are not to constitute any important or conspicuous part of the object and in no case should their combined weight be more than five percent of the whole.

Aside from these limitations in materials, you may do as you please. The boards can be cut up in any way desired and resawed into thinner boards. It is not necessary to use all the materials; indeed, any of the items on the list can be omitted entirely.

The prizes will be as follows:

First prize	$ 50
Second prize	25
Third prize	10
Fourth, fifth, and sixth prizes, $5 each	15
Total prizes	$100

THESE SUGGESTIONS MAY GIVE YOU A START

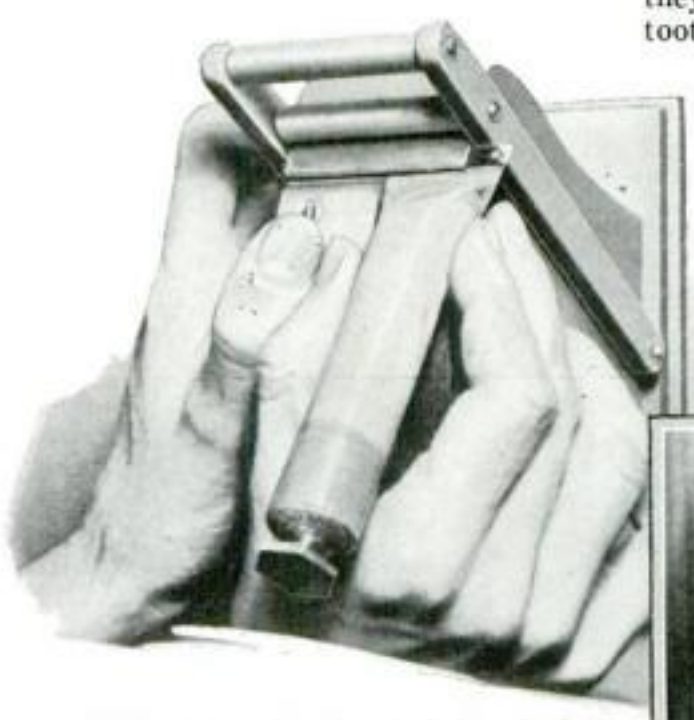
Airplane Model
Bird House
Book Ends or Rack
Book Holder
Candle Sconce
Clock Case
Clothesline Winder
Coach Model
Combination Bench Hook, Shooting Board, etc.
Desk Set
Drafting Set
Dryer
Fishing Tackle Box
Footstool
Games
Kitchen Rack
Letter Rack
Magazine Rack
Mirror Frame
Miniature Golf Set
Photograph Easel
Plant Stand
Ship Model
Shoe Shining Box
Smoking Set
Stationery Holder
String Winder for Kite
Telephone Shelf
Tool Box or Rack
Toy Furniture, Boat, Motor Truck, Locomotive, Gun, Scooter, etc.
Trellis
Waste Paper "Basket"
Weather Vane

You will see at once that there are almost unlimited possibilities in this contest. The objects may be of a decorative or instructive nature such as models, or they may be useful articles such as the tooth paste or shaving cream tube "squeezer" illustrated, which was designed and constructed to meet the conditions outlined. The list given in the box above contains a number of possible projects, some of which will probably suggest other more interesting and ingenious subjects to you.

The contest is open to all except employees of POPULAR SCIENCE MONTHLY and their families. All that is necessary to enter the contest, after you have made a suitable article, is to mail a clear photograph of it (or photographs, if you prefer) to the Woodworking Contest Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, on or before August 31, 1931. The photograph must show the object in the bare wood before any paint or other finish is applied, and it should be accompanied by (1) a brief description, (2) an itemized list of the materials used, and (3) a rough diagram or pencil sketch showing how the two boards were cut up.

Each entry will be judged on these points: (1) the ingenuity and originality of the idea, (2) the object's utility or decorative value (or both), and (3) the quality of the craftsmanship displayed. In case of ties, each tying contestant will be awarded the prize tied for.

The judges will be the technical and home workshop editors of POPULAR SCIENCE MONTHLY, and their decisions will be final. They will have the right to ask any contestant to send the actual article he has made to New York for their inspection, with the understanding that it will remain his property and be returned promptly. The names of the winners will be announced as soon as possible after the close of the contest.



Above: How the crimped end of the tube is inserted under the metal clip. *Right:* Moving the handle down squeezes out the cream.

FOR those who desire to make the convenient tooth paste or shaving cream tube "squeezer" illustrated, the construction is as follows:

From the ⅞-in. piece of white pine or poplar, cut three segments so that, when fitted together, they form a block similar to that shown in the photographs. The curve on the front face should be an arc of a circle. The dimensions of the block are: Width of curved surface, 2¼ in.; length of curved surface, 5 in.; and radius of arc (distance from face to a point ¼ in. from base), 4½ in.

The moving parts consist of two birch or maple strips measuring ¼ by ½ by 6¼ in., between which are fastened two sections of ⅜-in. dowel rod. Cover the curved face with sheet copper or other metal, the top end of which is bent over so that it forms a clip to receive the flattened end of the tube and prevent it from slipping.

The base can be made from two pieces of ¼-in. maple or birch.

Sturdy Ping-Pong Table Built for $5

By W. E. DURBAHN

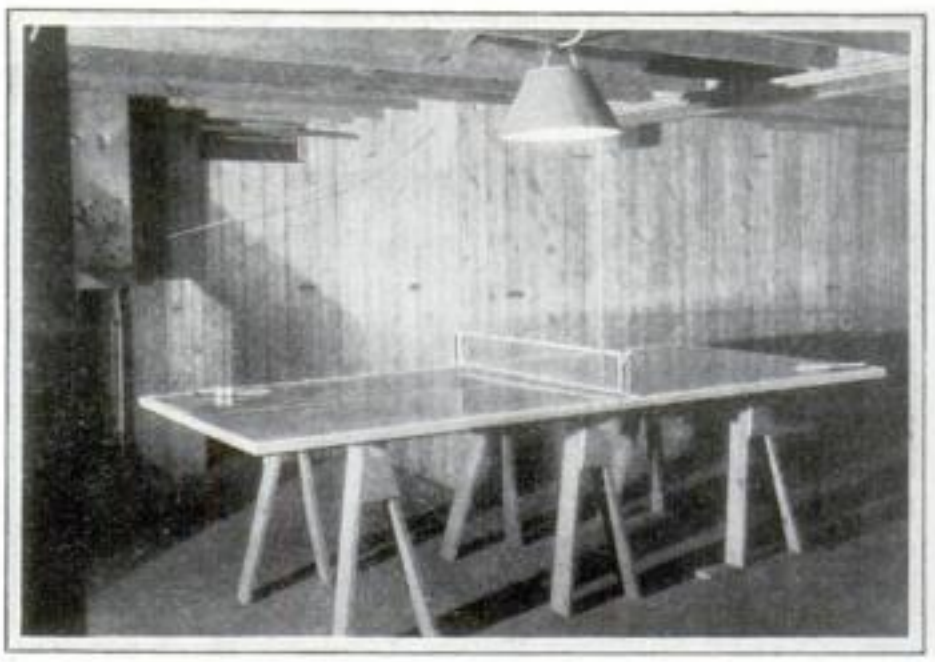
HERE is a sturdy, hard-surfaced ping-pong table that can be constructed easily at an expenditure of $5 or less. The materials are readily obtained and the work should not take more than a few hours' time.

The playing surface, which is a 4 by 9 ft. section of thick, flat plaster wall board, is reënforced on the underside with a 1 in. thick frame of 1 by 2 in. spruce. The two pieces marked *D* extend the full length, and the pieces *E*, *F*, and *G* fit between them.

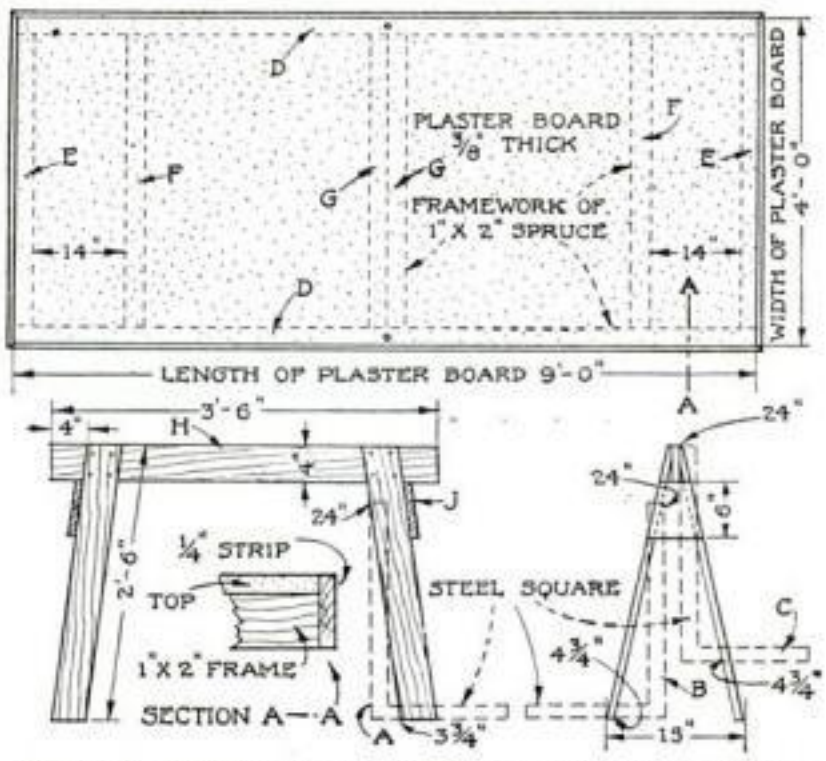
Fasten the framework to the wall board with twopenny lath nails. Drive the nails through the plaster board into the frame and space them about 4 in. apart. If desired, the table can be cut in two and hinged to facilitate storing.

The legs of the three horses and the tops *H* are of 1 by 4 in. stock. Lay out and cut one leg first; then use the completed leg as a pattern for the others.

The angles at which the legs must be cut in order to rest firmly on the floor can be laid out with a large steel square as follows: Place the square in the position *A* on the stock with the 24-in. and 3¼-in. marks as indicated. This will give the angle for the side cut needed at the bottom. Next turn the board on edge and place your square as at *B*, giving the angle cut on the edge at the bottom of the leg. Measure the length, 2 ft. 6 in., and lay out the angles on the top end. The cuts on the bottom ends are the same. The side cut at the top of the leg is laid out by placing the square as at *C*, using the figures indicated, and marking the angle on the stock along the 24-in. edge of the steel square.



A smooth, flat sheet of plaster board forms the playing surface of this ping-pong table. Two coats of enamel supply a hard finish.



Drawings showing construction of the supporting frame for the plaster board and the method of laying out the horses.

With sixpenny nails, fasten the legs in position, 4 in. from the ends. Place the horse on the floor, spread the legs to 15 in. as indicated, and nail the pieces *J* in place. These will not only hold the legs in position, but will serve to strengthen the horse.

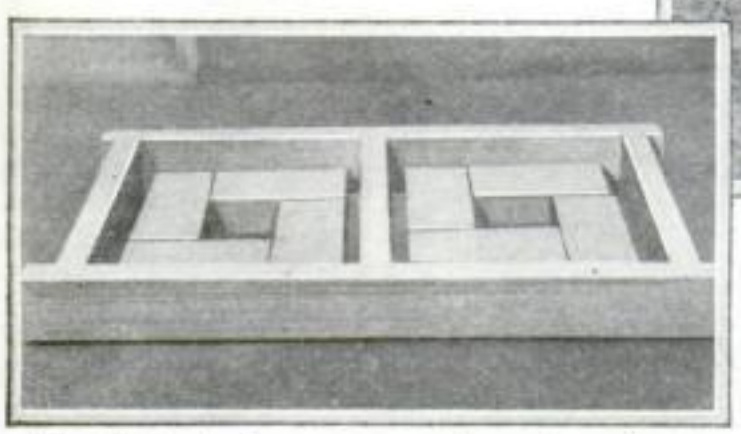
When the three horses are completed, lay the plaster board top on them and fit and nail a ¼ in. thick lattice strip around the edge. This will serve to protect the edges of the table, but be sure that it is flush with the top. Bore two ½ in. diameter holes in the top for the net supports and insert two 8-in. lengths of ½-in. dowel rod.

Two coats of quick-drying enamel will give the table an extrahard finish. If the plaster board is given a coat of glue size, one coat of paint on it may be sufficient. Stain the horses, if desired.

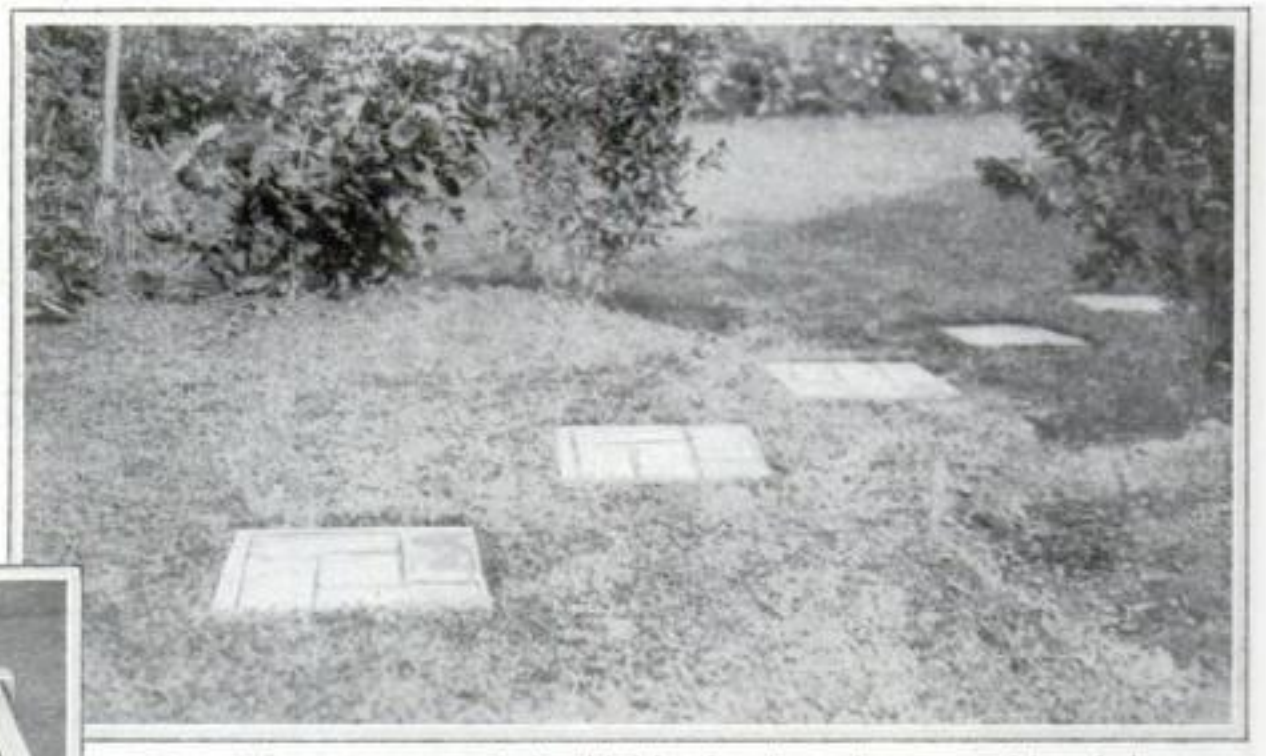
NOVEL STEPPING STONES INLAID WITH BRICK

WHEN placed informally at the points of greatest wear, stepping stones will protect your lawn and form an attractive and colorful design which will enhance the beauty of the garden.

Novel stepping stones, inlaid with glazed brick, can be made simply and inexpensively. First prepare a form similar to that shown below by nailing together two 3-ft. lengths and three 14-in. lengths of two-by-four. This will serve as a form for two stones.



How the two-by-fours are arranged so as to make two forms for the concrete. Note how bricks are placed.



By molding concrete around glazed bricks of various colors arranged in a design, you can provide your lawn with stepping stones that are attractive as well as durable.

Grease or oil the inside of the form, place it on a board, and put four glazed bricks in each square, arranging them in an attractive design. The forms are then filled with a 1:2:3 mixture of cement, sand, and gravel. If gravel is not at hand, use 1 part of cement and 4 parts of sand.

Set the stepping stones flush with the surface of the ground so that the lawn mower can be used.—LEWIS SHIRLEY.

Tips *on* Tempering Tools

You can do it with ordinary home workshop equipment if you know what the colors mean

By MARK H. SCHLIEPER

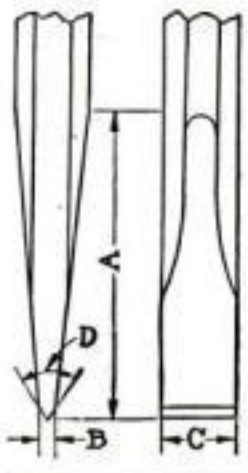
In oval: Plunging tool to harden. *Left:* Polishing the hardened end. *Above:* Watching the temper colors on the polished end to decide when to quench tool.

MANY ordinary tools can be hardened and tempered successfully by the home worker, even if he has no more equipment than a Bunsen burner and a piece of heavy scrap steel for an anvil.

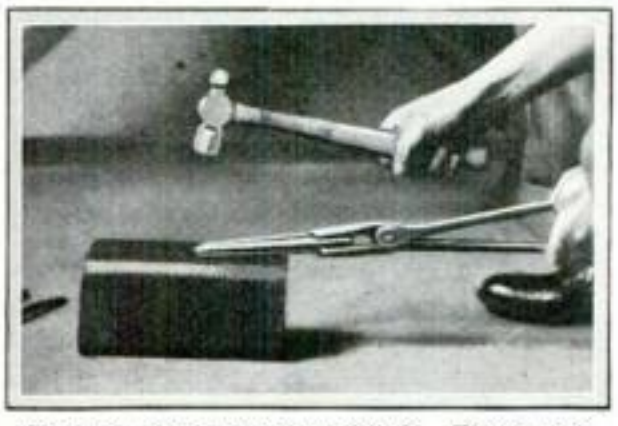
Reshaping an old tool. Heat until workable, but not beyond a medium yellow, and hammer to shape as necessary. Then anneal by heating to cherry red and allowing to cool in the air.

Testing quality of steel. First method: Heat sample red-hot and plunge in water; if file will not nick it, it is tool steel. Anneal this piece if it is actually to be used. Second method: Grind sample and note spark. Tool steel throws a bright yellow, starry spark; common steel, a spark of the same color but dull and solid, not explosive; high-speed steel, a deep, almost blood-red spark. High-speed steel requires white heat for hardening so cannot be treated unless a gas furnace or forge is available.

Hardening ordinary tools. If only the end is to be tempered, as is usually the case, heat the tool slowly and evenly red-hot for a distance, on the average, of about 2½ in. Do not heat beyond a bright red. Plunge about 1 in. into water and move it about continuously. When the upper portion of heated section cools to dull red, remove, test end with file for hardness, polish it quickly with emery cloth, sandpaper, or on a grinding wheel, carry it to good daylight, and watch the polished surface for the appearance of hardening colors.



STOCK	A	B	C	D
3/8"	1¾"	3/32"	3/8"	60°
½"	2⅛"	⅛"	½"	60°
5/8"	2¾"	5/32"	5/8"	60°
¾"	3½"	3/16"	¾"	60°
1"	3¾"	¼"	1"	60°



Data to aid in shaping chisels. These may be forged on any heavy piece of scrap metal.

Above: Applying additional heat to shank of a heavy tool which did not retain sufficient heat for tempering. *At right:* Heating thin tool over a hot slab.

When the desired color appears (see following list), plunge the tool in water to cool.

Colors for tempering various tools. Light brownish yellow, known as light straw, which is the first color to appear, represents the correct heat for quenching scrapers, scratch awls, and brass cutting tools. A darker brown, known as medium straw, comes next; it is the color for end mills, reamers, engraving tools, and hollow punches. A still darker brown, known as dark straw, next appears; it is used in tempering knurlers, punches, taps, dies, wood turning tools, and lathe tools for cutting soft steel. Then these colors follow: Purple—prick punches, cold chisels, stamping tools, and stone cutting tools. Blue—drills for metal, hatchets and axes, wood tools, and springs. Blue gray—screw drivers, wood screws, and knives.

Hardening thin tools. Knife blades and other thin tools are heated, plunged in oil, and then polished and reheated by passing them back and forth over a gas flame until a blue-gray color appears; or they may be held as shown over a flat, fairly thick slab of previously heated iron.

Oil hardening. Better results can be obtained by hardening in oil than in water. A thin oil such as whale oil is best, but any light lubricating oil may be used. Do not bend over the oil, as it often flashes into flame as the red-hot steel touches it.

To supplement this brief article, Mr. Schlieper, who is a teacher of many years experience and an authority on metal working, has prepared some additional notes. You may obtain these by sending a self-addressed, stamped envelope for Home Workshop Bulletin No. 6.

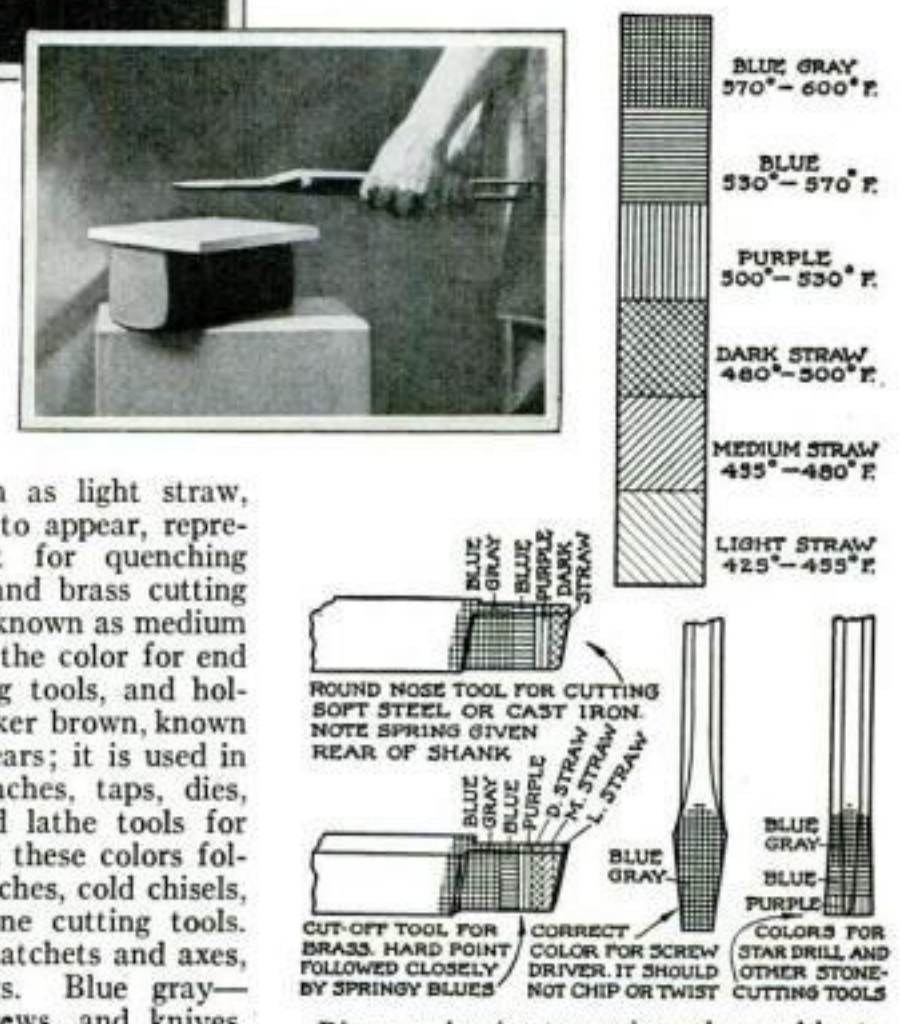
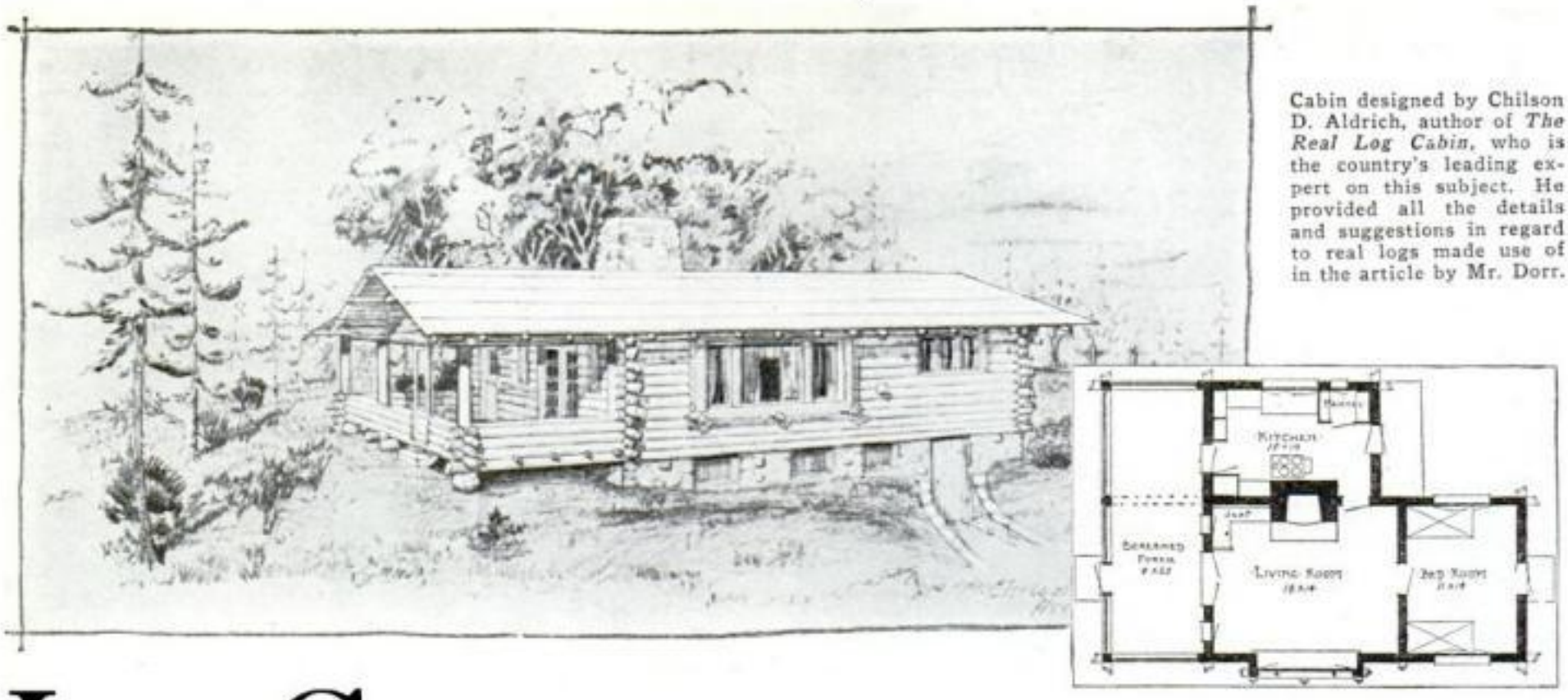


Diagram showing tempering colors and heats they indicate, and four well-tempered tools.



Cabin designed by Chilson D. Aldrich, author of *The Real Log Cabin*, who is the country's leading expert on this subject. He provided all the details and suggestions in regard to real logs made use of in the article by Mr. Dorr.

Log Cabins Anyone Can Build

For only twenty-five cents you can have a blueprint with complete plans for the log cabin shown at the top of page 93, as well as a list of the materials (see page 117). These drawings show how to apply the new type of log siding which has brought cabin building within the reach of everyone—knotty pine boards with rounded faces that look like heavy logs. There are also sketches on the use of real logs.

By WILLIAM GREY DORR, A. I. A.

IT'S a safe bet that a log cabin is the most satisfactory type of summer home—the kind that is in everyone's dream. A cabin seems to suggest peace, health, freedom, and also a lot of fun combined with just a dash of work to make one hungry for meals and ready to go to sleep the moment one's head touches the pillow.

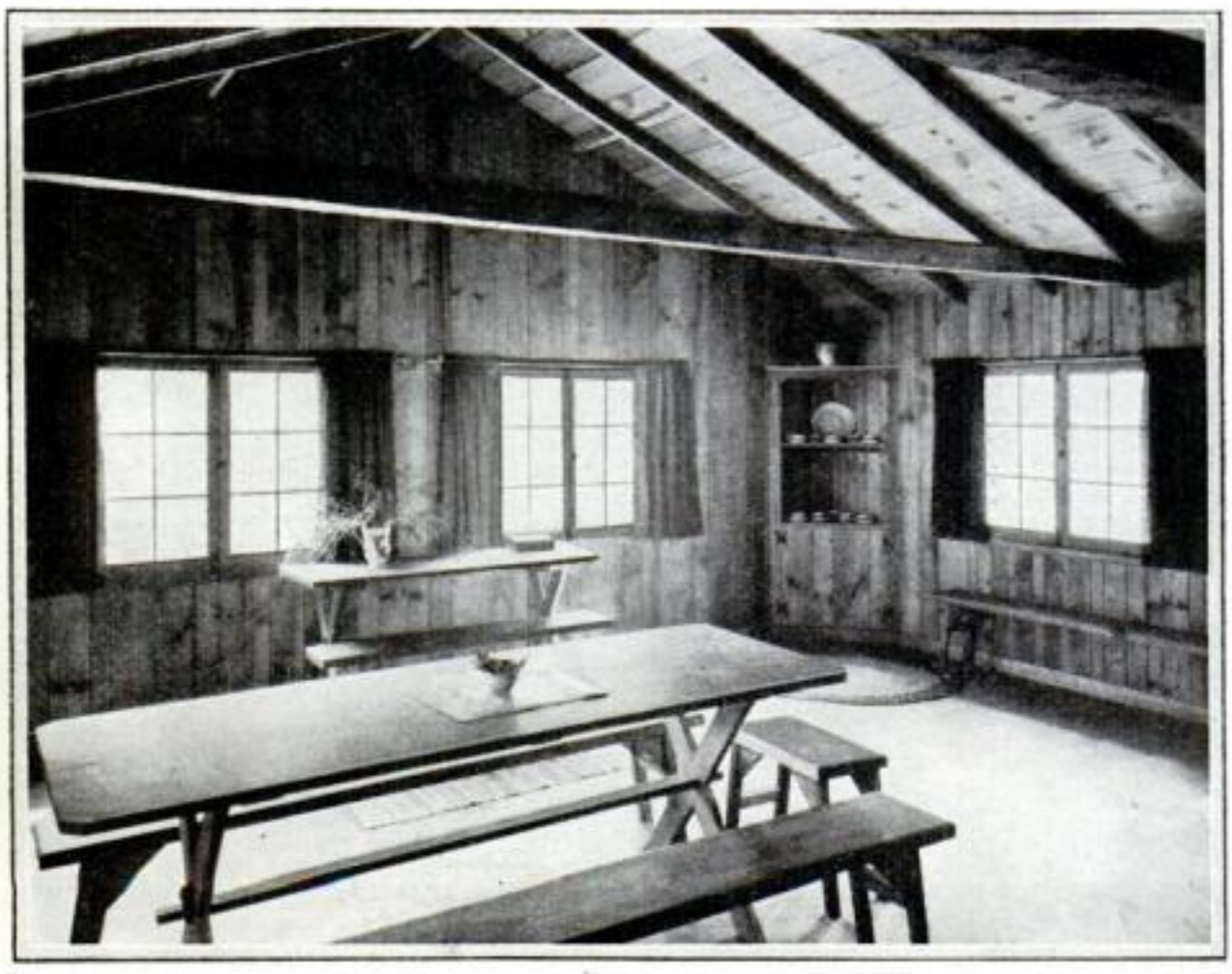
In those parts of the country where the "makin's" of a log cabin grow on one's own land, it will probably be easiest to build with real logs. But there are many choice spots where either the wood is too hard to be practical for working up into a cabin, or there are (alas, that we were not conservation-minded long ere this!) no trees at all that can be spared. You may have a picturesque cabin nevertheless, and one that is reasonable in cost if you aren't afraid of exercising that good right arm of yours.

First of all, make sure that you have an adequate plan—one that will cover all your needs. How much and how many? is the double question to put to yourself. Don't try to make your cabin so small that you will have to sleep four in a bed, but don't have too much extra space to look after. And, above all, have it both in design and in furnishing just as simple as it is possible to make it. Avoid gimcracks within and without.

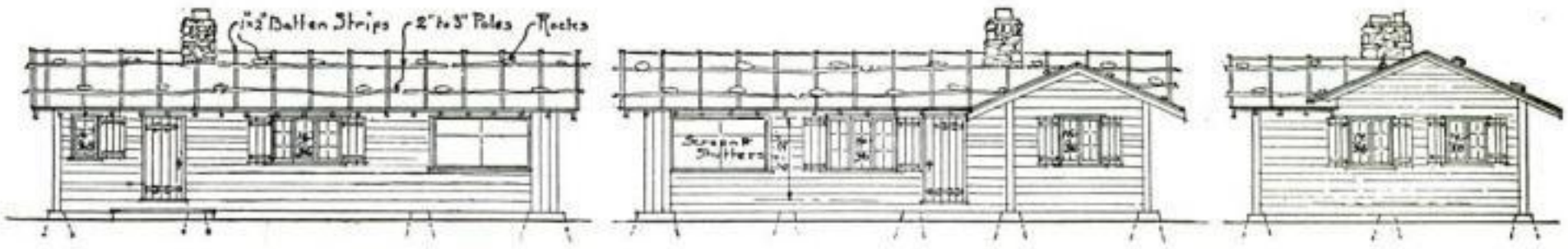
The floor plans shown here, both of the real log cabin above and that of the cabin of siding on page 98, are simple and compact. In each case the porch is utilized as an extra sleeping room—which always suits the youngsters and at least some of the oldsters. The living room "doubles in brass" by being the dining room as well; and the bedrooms may be fitted with double bunks which can be made in a picturesque fashion that suggests an old four-poster with a "tester" top. By this method a fair number of people can be comfortably accommodated in a reasonably small space.

Low roof lines, wide eaves, and well-fitted corners—whether of real logs or of the siding—give a quaint look that is desirable in one's holiday home. The difference in a cabin that you like and one that looks like something a trapper threw up in a moment of stress is so great that one can hardly overestimate the importance of having a professional design to start with.

Equal in importance is the construction. If you have the logs and can employ workmen who know how to wield a cun-



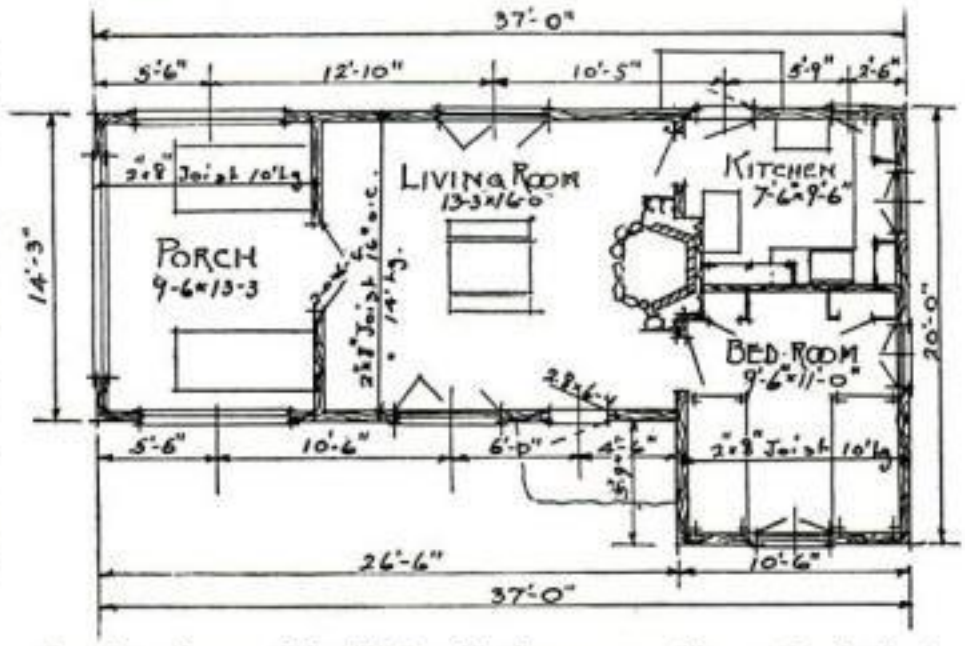
Simplicity is the secret of building an attractive log cabin. In this living room designed by Mr. Aldrich, the walls are lined with plain boards, and the furniture is all built to harmonize.



ning axe as well as to do some carpentering, you are in luck and probably will choose the real log cabin. But you may elect to use either the newly developed type of log siding which has a rounded face that closely resembles real logs if laid up in random widths, or the ordinary bungalow siding, both of which are applied over a stud construction like any frame house. Most reasonable of all in cost are common boards lapped like siding and stained a light brown. These give a satisfactory and picturesque effect.

Whatever type of construction you choose, however, the base construction may be the same. The log cabin *Sarona*, shown at the beginning of this article, is built with full basement; and if such is your choice, it is wiser not to attempt to do it yourself unless you are a fairly competent mason, for it is a tricky job. More than one amateur who has attempted it has decided that it was more than worth the money to let George do it.

For any cabin that is not to be used in very cold weather, concrete piers make a satisfactory base, and if the effect of a continuous foundation wall is preferred, it may be obtained by filling in between the piers with a "curtain wall," as it is called, of not less than 6 in. in thickness. Such a wall should be built of rocks or of concrete faced up with rocks rather than concrete alone, as rocks give a look of stability and also harmonize better with rustic surroundings than a smooth surface upon which your rough-textured cabin is to rest. In any case make sure that the piers are sunk down to solid ground. The curtain wall, however, need penetrate only below the humus or forest floor.



Complete plans and details for this three-room cabin can be obtained by sending twenty-five cents for Blueprint No. 134 (see page 117). If built with log siding, the estimated cost for all materials is $1,200.

A word as to corners: Whatever type of construction you elect, corners may make or mar the appearance of your forest home. In the log construction much of the picturesqueness is gained by the random length projection of the axe-cut ends. The logs may be fitted by any one of three methods, but the saddle-and-notch joint is the best for the amateur to attempt. This means an inverted V-notch cut in the upper log and a "saddle" cut in the lower log so that they can clinch somewhat like one's two hands when gripped together.

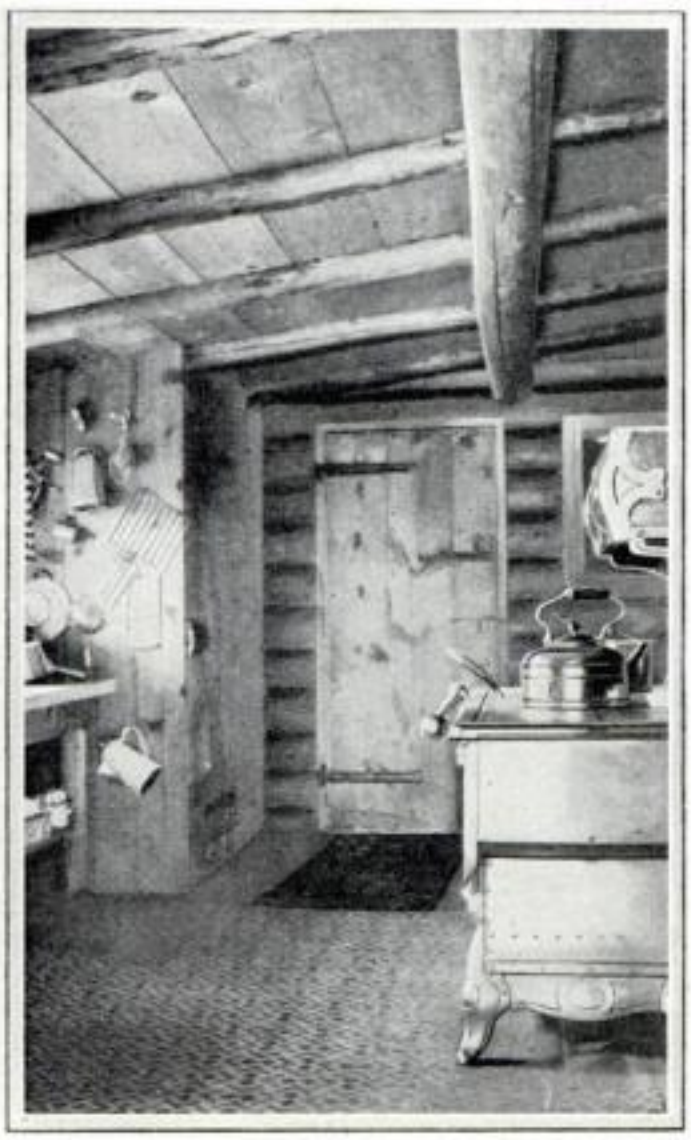
The logs may be fitted together throughout their length by flattening them off to get rid of any bumps or irregularities so that they will lie flat together. This type of fitting is made tighter by bedding plumbers' oakum on the saddle before rolling the upper log into place; and, after the roof is on, more oakum is driven between the logs by a mallet and calking iron.

The corners of the siding—whether with a curved face or flat—should be butted against vertical corner boards of the same material rather than mitered at the corners. It is an easier construction and has a more finished look as well. Common board siding, however, may be mitered.

Various kinds of roofing may be utilized. The main consideration is to have it suit the character of the building and yet be reasonable in cost. Slate-coated roll roofing is the cheapest for both the real log cabin and the one of siding. There are, however, various types of prepared spark resisting shingles that may be used. Regular cedar shingles or those that resemble old-fashioned "shakes" make a good roof.

The roll roofing may be applied horizontally in the usual way with carefully cemented and nailed joints. Another more interesting method is to apply the roofing vertically, continuing it right over the ridge and down the other side to the edge of the roof boarding. The joints are cemented, nailed, and covered with batten strips. An effect similar to a Swiss chalet roof is obtained by laying poles horizontally over the battens and holding them in place by rocks.

In the August issue Mr. Dorr will give suggestions on doors and windows, fireplaces, furnishings, and other details relating to log cabin construction.



An attractive log cabin kitchen. Here genuine logs have been used, the joints calked with oakum.

Log siding can be applied inside as well as outside a studding framework to imitate this effect.

Useful Hints for Car Machinists

Fig. 1. Old oil can and rod put together make a home-made engine stethoscope.

POPULAR SCIENCE MONTHLY awards each month a prize of $10, in addition to regular space rates, for the best idea sent in for motorists. This month's prize goes to L. D. Youmans, Ravena, N. Y. (Figure 1).

IT IS extremely difficult to locate the exact source of a noise in the auto motor merely by listening with the hood raised. The device shown above in Fig. 1 applies the principle of the doctor's stethoscope. Take an old oil can and discard the spout. Then solder a long thin metal rod to the bottom as shown. The can concentrates the noises travelling up the rod from the motor.

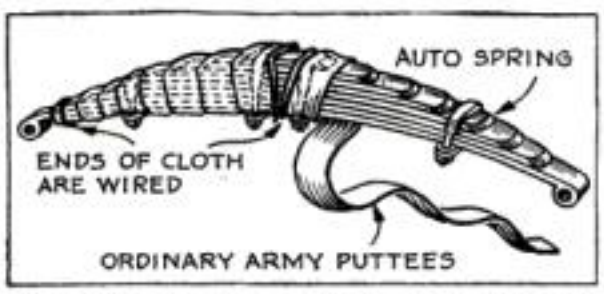


Fig. 2. Springs will grease themselves if they are wrapped in an old puttee soaked in oil.

GOOD riding qualities in the modern motor car depend on adequate lubrication of the springs and adjustment of the shock absorbers. The ordinary method of lubricating the springs is effective but must be repeated at short intervals. Fig. 2 above shows a way to make the springs self oiling and at the same time keep out dirt and grit. Army type puttees made of wool cloth strip can be obtained in many stores at low prices. Wind a pair of these around each spring, wiring the end in place, then soak them with the old oil drained from the car's crank case.

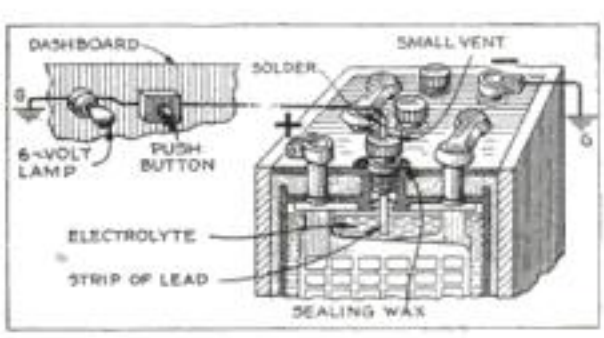


Fig. 3 shows how light on the dash can be hooked up to tell solution level in battery.

UNTIL the solution in the auto storage battery drops considerably below the level of the top of the plates, the battery continues to give perfect service. However, operating the battery with the solution level too low ruins the electrical qualities of the portions of the plates left exposed. Fig. 3, at the bottom of the first column, shows a way to determine the solution level whenever desired merely by pressing a button on the dash.

Locate the filler cap nearest the positive pole of the battery (in batteries having the positive terminal grounded to the frame of the car the filler cap nearest the negative pole should be located). Drill a hole in this cap so as to make a tight fit around a lead rod. Adjust the length of the rod so it clears the tops of the plates when the cap is screwed tight.

Drill an extra venthole beside the lead rod. Connect the end of the lead rod to a switch on the dash and run a wire from the other terminal to a light, grounding the other terminal of the light. When the switch is on the light will burn as long as the solution level is above the tops of the plates.

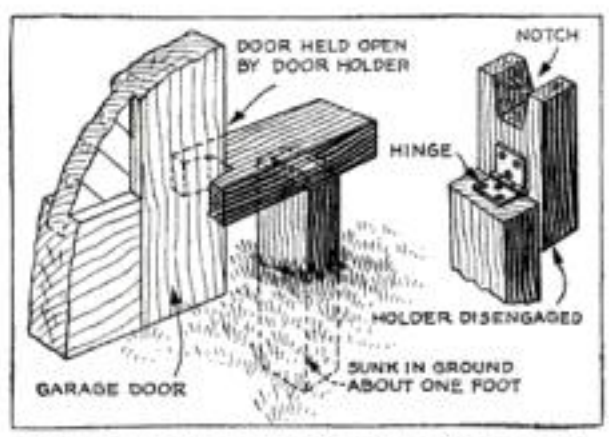


Fig. 4. Here is a new and simple device made of two by four to hold the garage door open.

MANY types of garage door stops have been described on this page. The one shown in Fig. 4 is especially easy to make. The size of lumber needed depends on the thickness and weight of the door. In most cases pieces cut from a length of two by four will do the job. The length of the notched piece, and also of the vertical section, can be varied to meet special requirements.

In any case be sure to have the vertical post set at least a foot in the ground and it is desirable to have the locking piece as close to the ground as possible to reduce the strain on the upright. Be sure that the locking piece is so placed that the hinge is much closer to the back than to the notched end.

IN THE case of an ordinary puncture, the regular five minute self vulcanizing patch or the cemented patch will do a good job. However, when the tire suffers a bad blow-out, the tube usually is ripped, sometimes for several inches, and often a piece actually is blown away. If the tube is old and near the end of its useful life it does not pay to repair such a bad break, but if the tube is relatively new, the method shown in Fig. 5, below, will prove effective.

First sandpaper all around the edges of the hole both inside and outside. Then cut a piece from an old inner tube and after sandpapering it on one side, cement it to the inside of the tube, thus repairing the hole from the inside. Then apply a patch to the outside in the usual way. Thus the hole will be patched and reënforced from both sides.

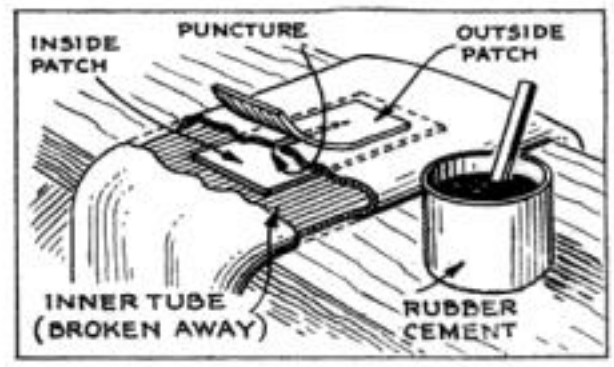


Fig. 5. A badly torn inner tube that is almost new can be saved with patch from old tube.

MANY types of old carburetors obtainable cheaply at the auto wrecking yard are of the type where the float chamber is separate from the mixing chamber. Such a carburetor can be altered as shown in Fig. 6 below to form a gasoline strainer. First saw off the float chamber. Then thread and plug the small hole through which gasoline flowed from the float chamber to the spray jet in the mixing chamber. In some cases a plug will be found on the opposite side to which the supply pipe can be attached. If not, fit to the spray jet supply hole after enlarging it to make a good fit.

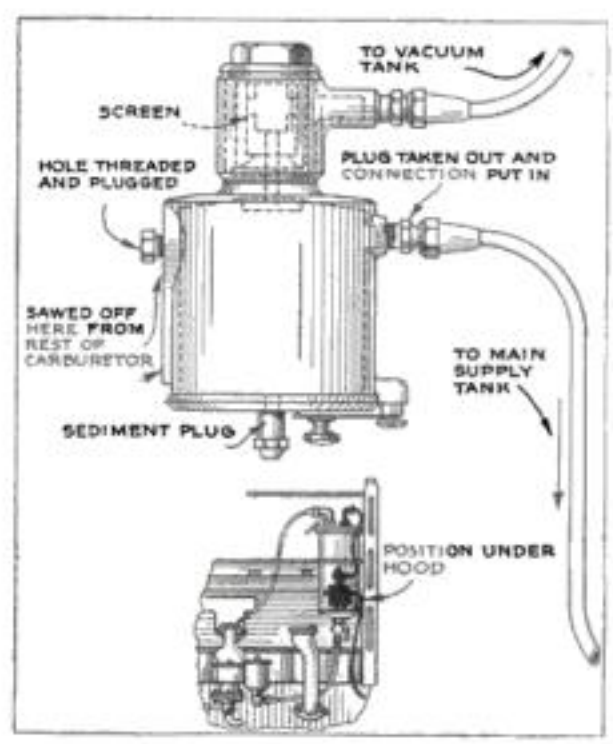


Fig. 6. Old carburetor, with float and mixing chambers separate, makes good gas strainer.

Old Bill and Bob Laten go visiting and discover a

New Tool for Precision Boring

By
JAMES ELLIS

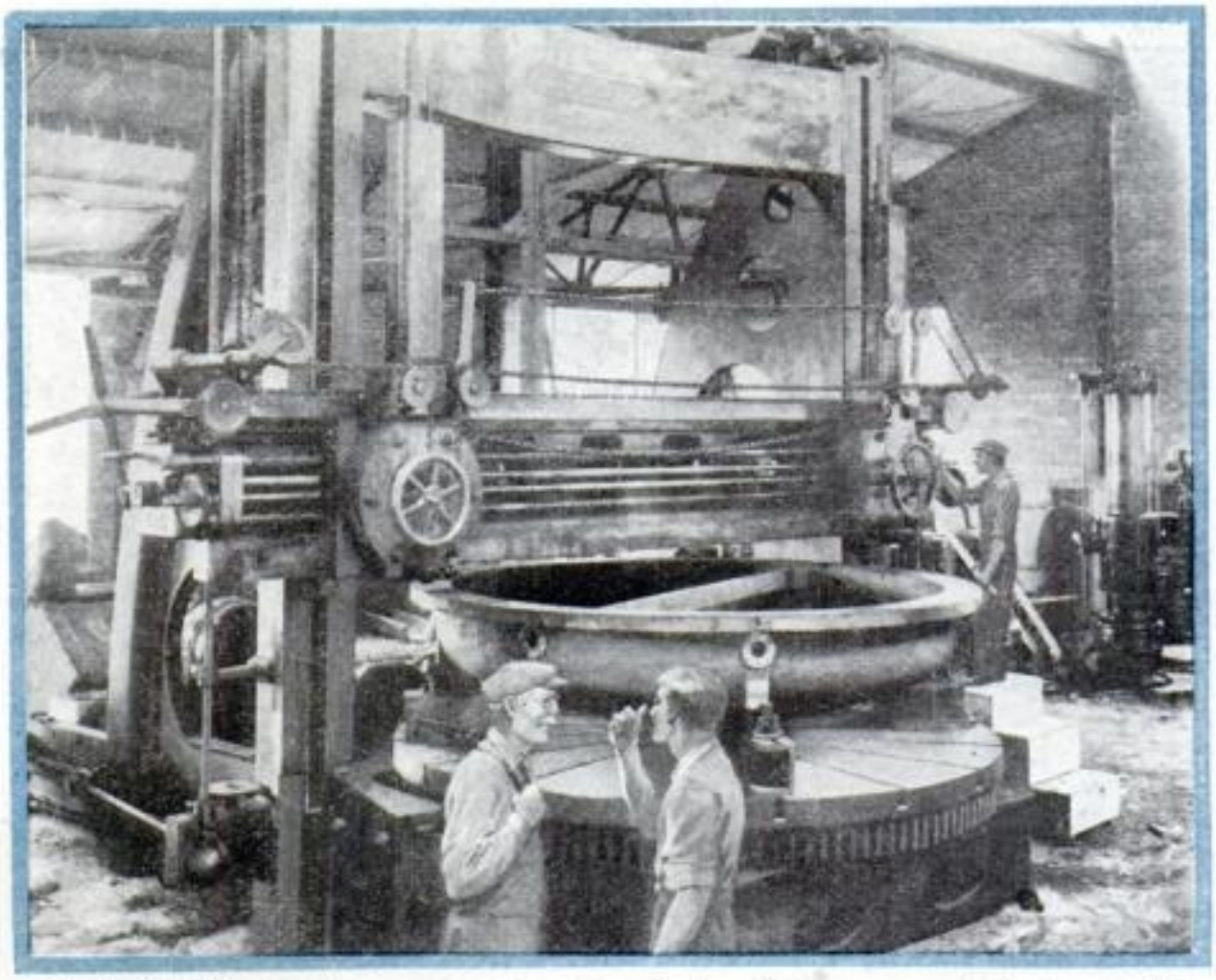


Fig. 1. Old Bill's attention was attracted to a large boring mill in one corner of the shop. It had a 16-ft. table on which was mounted such a gigantic casting that it made the table look small.

AS HE burst into Old Bill's office, Bob Laten was halted by the sound of voices. He had come to ask a question about the blueprint of a job that had him guessing, and there was a slightly puzzled frown on his face, but it gave way to a smile as he became aware of what Old Bill was saying to young Jimmie, one of the apprentices.

"You can't stay in one place and learn enough," Old Bill told the boy with kindly firmness. "You must find out how the other man does things, and then come back to me here. That is the best way to become worth more wages."

Bob Laten now grinned broadly. Not so many years before he had been told the same thing. He had gone roaming about the country for a time and had learned many things, until finally he thought it wise to settle down. Even now he sometimes had vague longings for the days when he could go from place to place when fancy dictated.

"Too bad we can't send Jimmie away right now to find out how I am going to get this thing machined accurately enough," Laten said as Old Bill turned inquiringly toward him. He unfolded the print (Fig. 2), which showed a part of the ingenious piece of mechanism that has come to be known as a "Geneva stop." It is a device for imparting a jerky motion to one shaft from another that revolves at a constant speed, and finds application in various special machines such as those for forming wire. Sometimes it is used in printing machinery, and, in a small form, on motion picture machines.

Old Bill looked at the print. He saw that the accuracy required was high, and that the part was bulky (see Fig. 2).

"Well, it seems to me that you ought to be able to mill the slots without much trouble," he suggested.

"Yes," Laten replied, "I can do that on the milling machine, but what's bothering me is how I am going to locate the circular portions, and how I am going to bore them true."

The expected reply did not come; instead, he saw Old Bill looking out of the window at the trees in the distance. There was a curious and almost wistful expression in Old Bill's eyes. Laten wondered if he, too, had a longing to escape the confines of the shop. In a way, Laten envied the boy who had just been told to go seek knowledge.

Old Bill returned to the print, and studied it for a moment.

"I have an idea—or at least I know where we are likely to get one," Old Bill said. "Get your hat and we will do what I told the boy to do. We'll go over to F. J. Wilhelm's place and ask him."

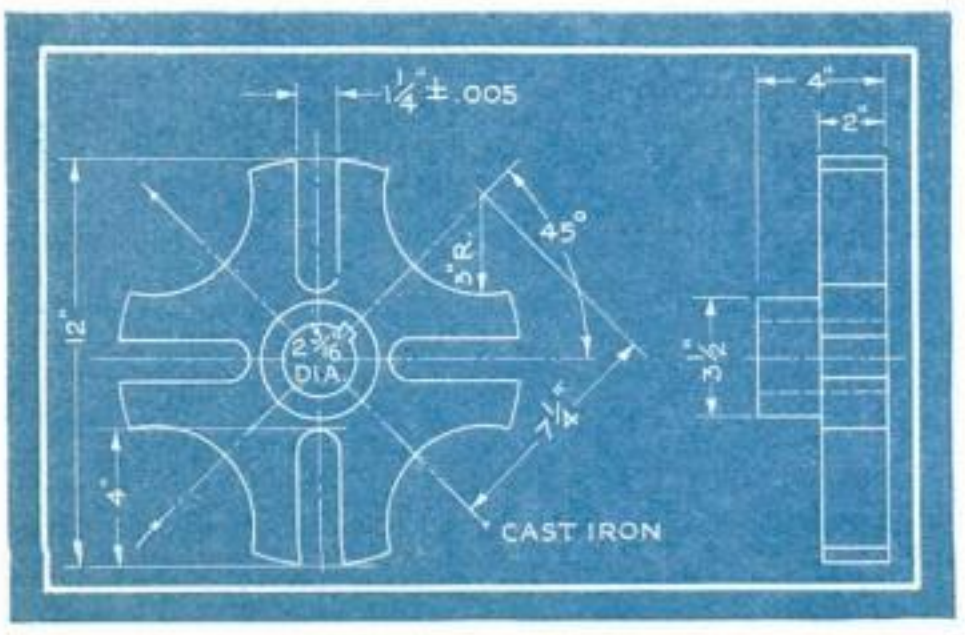


Fig. 2. The blueprint of the 12 in. diameter "Geneva stop" which prompted Old Bill and Bob Laten to pay a visit to Wilhelm's shop.

Bob Laten assented with enthusiasm. It was just the sort of day he could enjoy a twenty-mile ride to the town where they were going. He and Old Bill climbed into the flivver and in about an hour they reached the shop for which they were bound.

When they arrived, they saw that the outside of the shop was being painted and that Old Bill's friend Wilhelm was out in front observing the painting—or sunning himself, they could not decide which. With the approach of their car, he was cordial in his greetings.

"Look who's come over to see me!" he exclaimed. "It's been months since I have seen you boys, and I am tickled to death to have you here."

Old Bill cast a quizzical eye at the painting and said, "You look so prosperous, we thought we would see whether we could get a job."

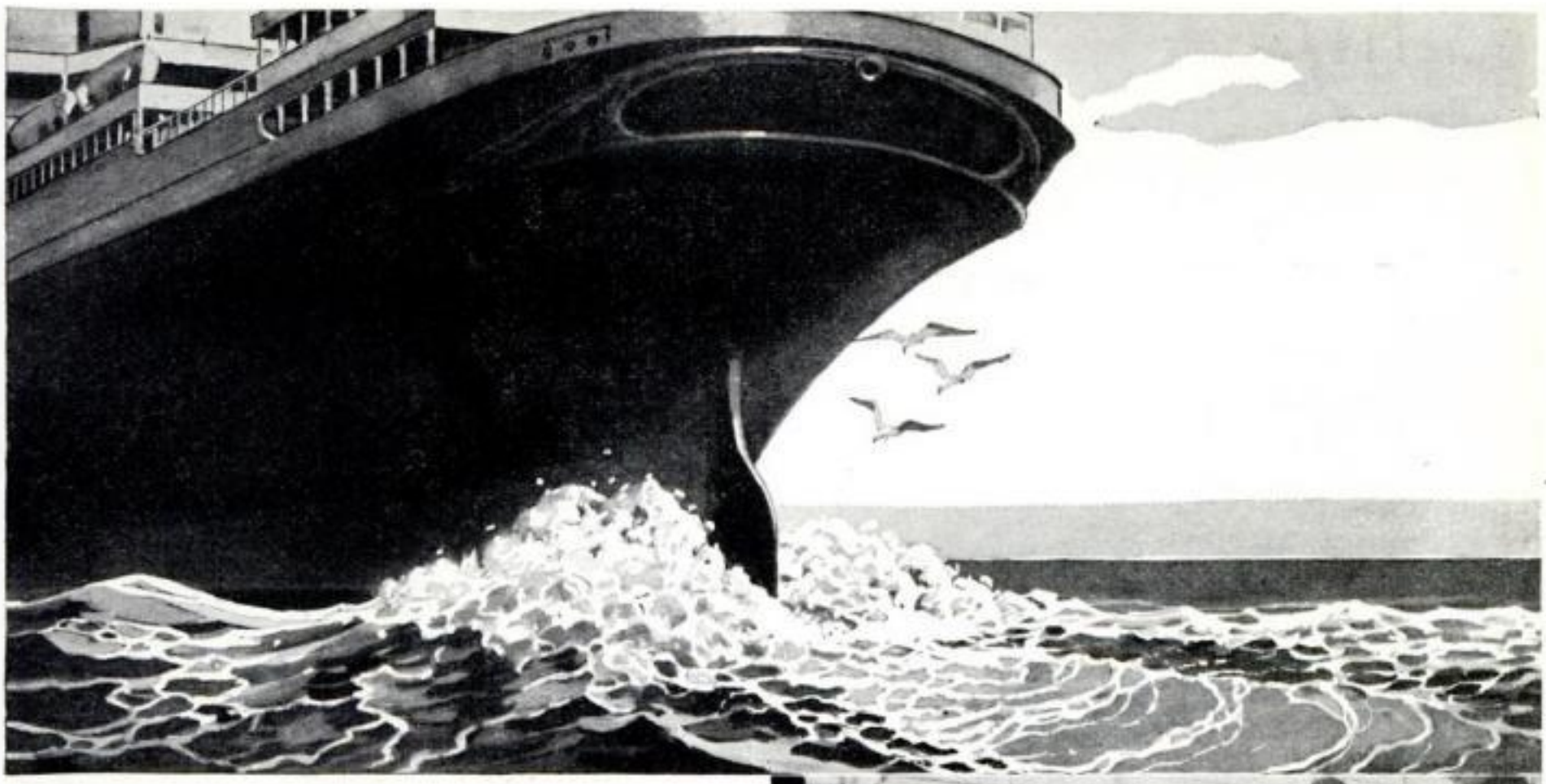
"You bet you can!" Wilhelm exclaimed. "But anyone who could get you away from that place of yours would be working a miracle. Let's go inside and see what there is."

The three went into the shop, each observing what was most interesting to him. Old Bill's attention—always thinking of new equipment for his own plant—was attracted to the big boring mill in one corner of the machine shop. He went over and stood before it. It was a big machine with a sixteen-foot table, but gigantic as it was, the casting on it made it look small (see Fig. 1).

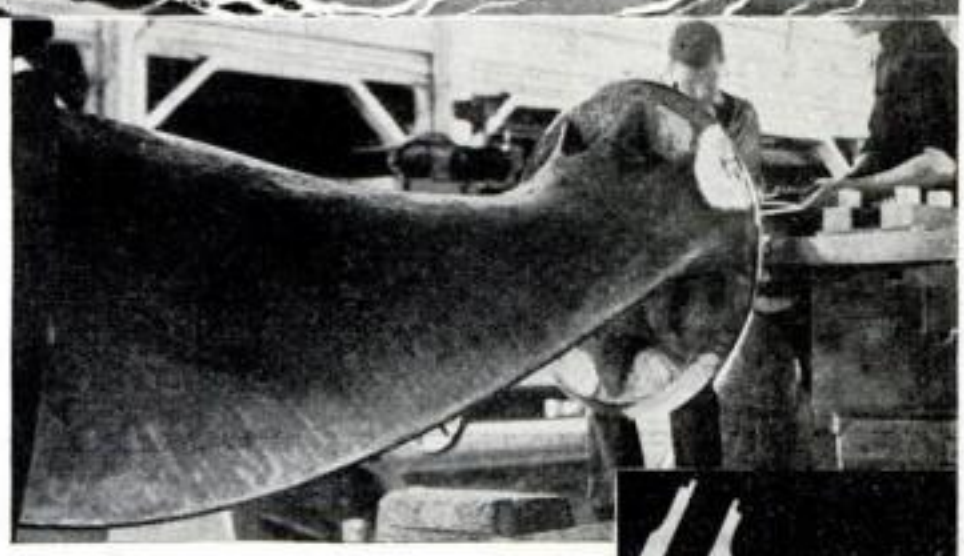
"That is the bottom casting for some sort of chemical apparatus we are building," Wilhelm explained. "We have cast several like that, and some of the plain sections that go on it to make a tank of some kind."

Continuing their way through the shop, Old Bill stopped at other jobs that caught his eye.

"I see you have two kinds of welding equipment," he commented. "We need a new welding machine ourselves and will



for a thrust of 90,000 H.P. you need true propellers!



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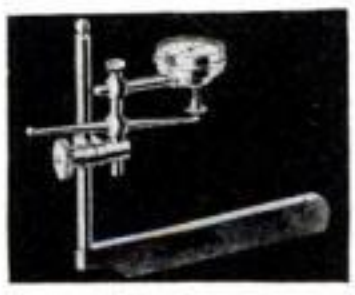

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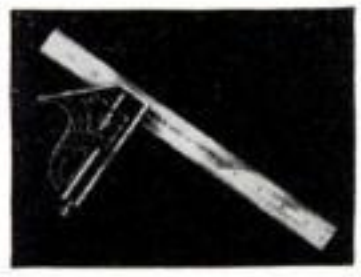

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soon have to buy one."

"Yes," his host replied, "we have found, as I suppose you have, that there is work which can best be done with gas, and other work which is better suited for electric welding. For example, over at our right we are brazing together some copper pipe with gas, and here we are making steel tanks with the arc."

Meanwhile Bob Laten had strayed over to the section of the shop where tools were made, and the finer work was done. When Old Bill and Wilhelm approached, he was gazing at a machinist at work placing a boring bar in a miller. The bar itself was of the type shown in Fig. 4.

"That is something new with us," Wilhelm explained. "We have found that a boring bar constructed in this way is of considerable advantage for precision work. It consists of a shank made to fit the milling machine arbor or the chuck, and it has an adjustable boring end that can be made to run absolutely true, as Jack is doing there now, just by holding a piece of steel against it before the knurled shell is finally tightened. Then he can set the tool to cut any diameter by calipering from the bar to the edge of the tool. This is a considerable advantage in case of half holes. Another point is that the bar, being absolutely true, can be used to locate a hole from an edge of the work."

Old Bill and Bob Laten grasped the idea instantly.

"That is just the thing we came over here to get!" Bob Laten exclaimed, unfolding the print which he had brought along.

He showed Wilhelm the job that had him stumped, and pointed out the weight of the parts and the accuracy demanded.

"You can finish bore segments of holes, if there is such an expression," Wilhelm said, "with a tool like that, and you can locate the work with another device that we have used from time to time."

He went to the tool cabinet near the milling machine and brought out an angle plate that had two studs projecting from its surface, or, more correctly, one stud and one plain pin as shown in Fig 3.

"Here is an angle plate with a stud which would be made a good fit for a piece such as you have to make," Wilhelm continued. "Then, located at the proper angle, is this hardened and ground pin. It would fit the slots in the casting you are going to machine. With this device, you would first accurately cut the four slots and then use the slots to locate the bored-out portions on the circumference of the casting. In that way you would be certain of getting the same relation on each of them."

Old Bill winked at Bob Laten, who was smiling with satisfaction at having learned how to get out of his dilemma.

"I told you we could find out from Fred Wilhelm," Old Bill said. "It's been worth all of this hard trip over here to discover this method," he added, laughing.

Fig. 3. The solution of his boring problem, Laten found, was to use a tool similar to the one Wilhelm had designed, and hold the work on an angle plate like that at the right.

"Hard trip, nothing!" Wilhelm exclaimed. "You were just hankering to get away from the shop. That's all there was the matter with you. Don't try to tell me you couldn't have doped this out for yourself!"

"Well," Old Bill rejoined slowly, "I still believe this was the better—and by far the pleasanter—way. Suppose you come out and have lunch with us?"

So, when the noon whistle blew a short time later, the three mechanics, one of the old school and two who were younger, were off to the near-by lunch room, there to swap yarns about their experiences and tell tales of shop problems met and conquered. And if you could have eavesdropped on them for five minutes, you would have learned at least part of the secret of their success as mechanics—they were whole-heartedly interested in their work.

This is another in the series of machine shop articles about Old Bill, who was first introduced to our readers in 1923.

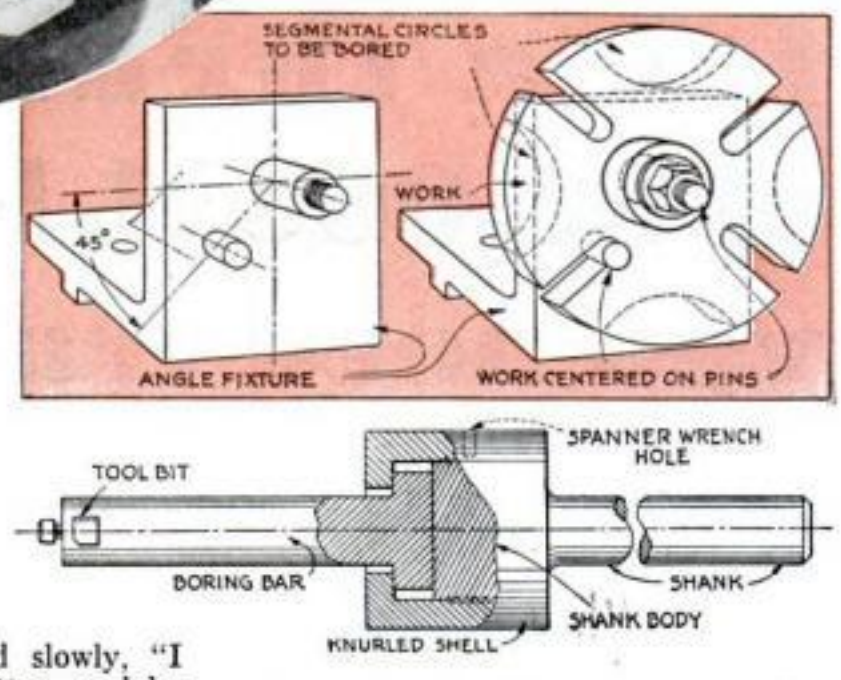
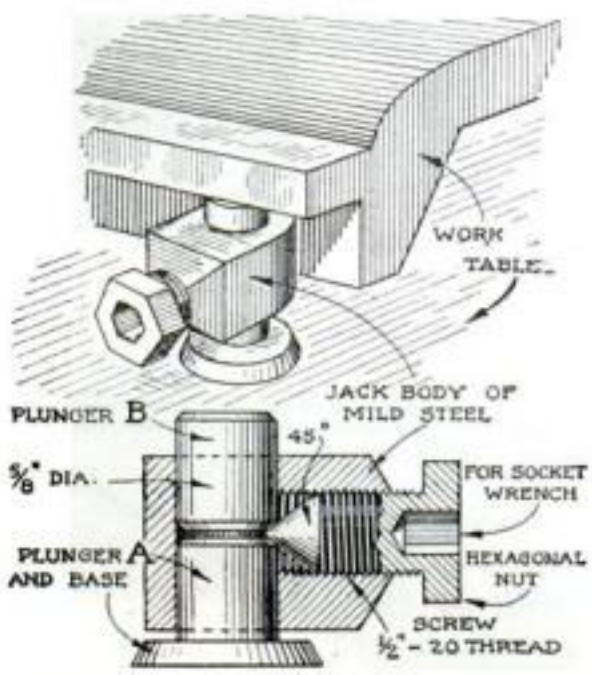


Fig. 4. How the adjustable boring bar for use in extremely accurate work is machined.

SMALL JACK AIDS IN LEVELING WORK

A TOOL accessory that the writer has used to advantage innumerable times in setting up accurate work on the miller or planer table is the work support or low-height jack illustrated. It allows very fine adjustment.



Where accurate leveling is important, a fine adjustment can be obtained with this jack.

The main body of the jack is made from mild steel bar, drilled and tapped as indicated in the sectional view. The plunger *A*, which is turned to shape on the lathe, has a wide base on one end and a 45° bevel on the other end. The plunger *B* is a length of ⅝ in. diameter drill rod beveled at 45° at both ends. Several different lengths of drill rod can be kept on hand in the tool crib, thus widening the useful limits of the tool.

A ½ in. by 20 die is used for the screw thread, and the end of the screw is ground to a 45° point. The other end is supplied with a hexagonal nut and is broached to take a socket wrench. The plungers and the screw are of tool steel, hardened to withstand wear.

In use, four or more of these jacks are placed under the work and the screws turned either in or out until the proper adjustment is obtained to bring the work up level.—C. H. W.

Micrometer Caliper
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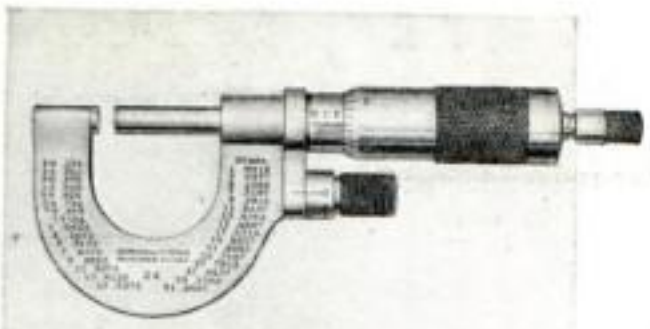
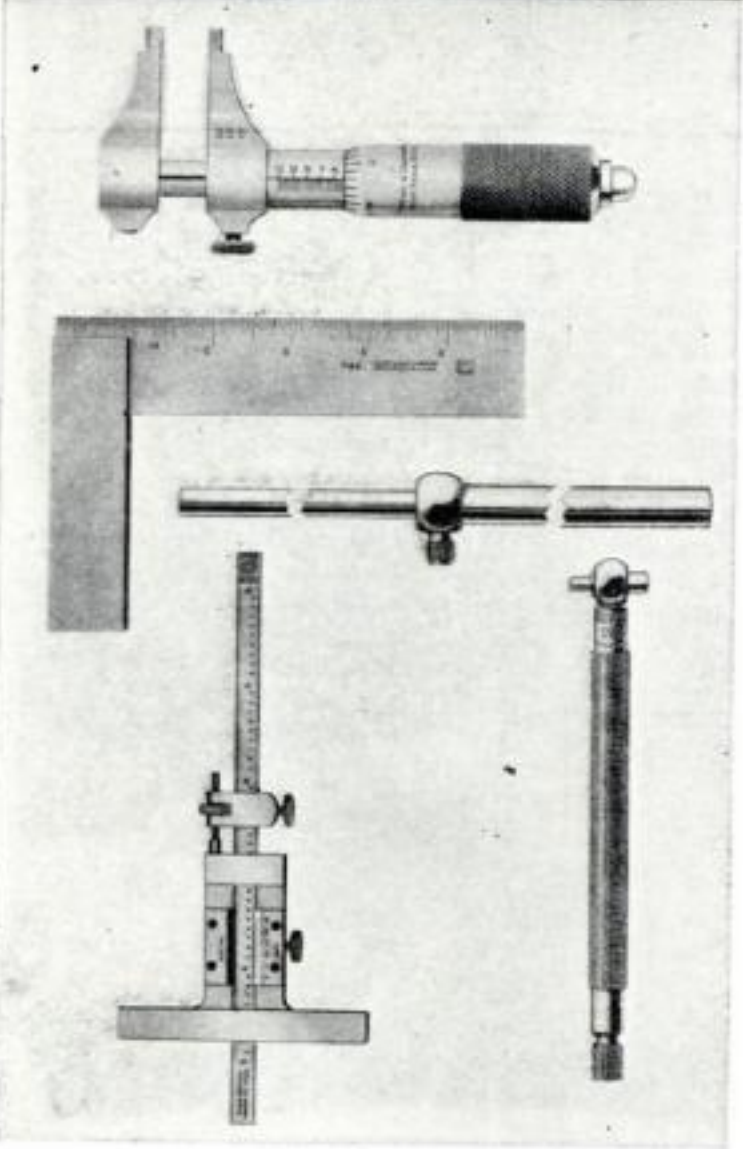
Range 0 to 1" by *ten-thousandths* of an inch

The most outstanding development in precision tools since the introduction of the micrometer. Ten-thousandths can be read as easily on this tool as thousandths on an ordinary micrometer.





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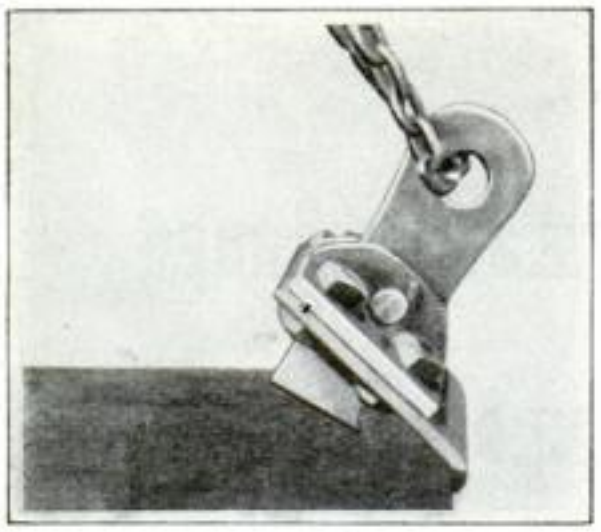


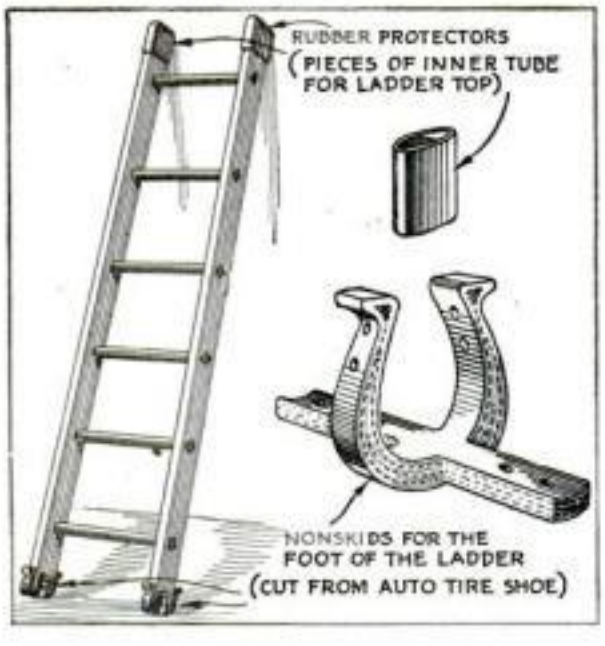
IMPROVED STIRRUPS FOR LIFTING SHEET METAL

In shops where a large quantity of heavy sheet metal is handled, the improved nonslipping stirrup illustrated above will prove to be an excellent safety measure. The stirrups are self-locking and grip the metal tightly.

The main body of this stirrup is similar to the ordinary type, excepting that its upper end is supplied with a 1 by 4 in. slot to take the pivoted finger which holds the sheet metal against the lower arm. This pivoted finger is made from a 12 or 14 in. length of 1 by 4 in. steel bar. In its upper end is a hole for the chain hoist, and at about its center is a hole to receive a 1 in. diameter steel pin. The inside lower corner of this member should be sharpened as shown in the illustration.

Sections of angle iron are bolted on each side of the slot and serve as supports for the steel pivot pin, which is held in place with cotter pins.

In use, a stirrup is slipped over each end of the sheet metal stock and, as the weight is taken by the chain, the lower ends of the pivoted members are pressed against the stock and prevent it from slipping.—Joseph C. Coyle.



SHOP LADDERS EQUIPPED TO PREVENT SKIDDING

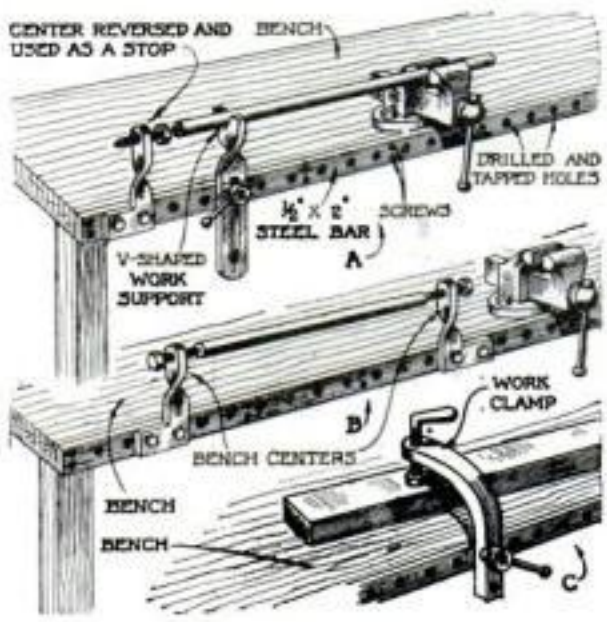
You can use your shop ladder with a greater feeling of safety if it is equipped with nonskid feet and ends.

Pieces of a discarded automobile shoe, cut to the shape shown, are secured to the feet of the ladder with nails. The top of the ladder is prevented from slipping sideways by stretching a few short lengths of inner tube, one on top of the other, over the ends of the uprights.

BENCH FIXTURES TO AID MACHINISTS

Machinists who have to do a variety of bench work can improve their benches by the addition of timesaving accessories like those illustrated in the perspective sketches below.

The work support and stop, bench centers, and work clamp illustrated at *A*, *B*, and *C* respectively are only a few of the handy aids that can be quickly fastened to the front edge of the bench if it is equipped with a ½ by 2 in. strip of cold-rolled steel as shown. This strip is drilled with a series of equally spaced holes,



Machinist's bench fitted with a front plate to which numerous fixtures may be screwed.

which are tapped to take the ⅝- or ¾-in. screws on the attachments. A few countersunk holes also are drilled for the screws used in fastening the strip to the bench.—Charles H. Willey.

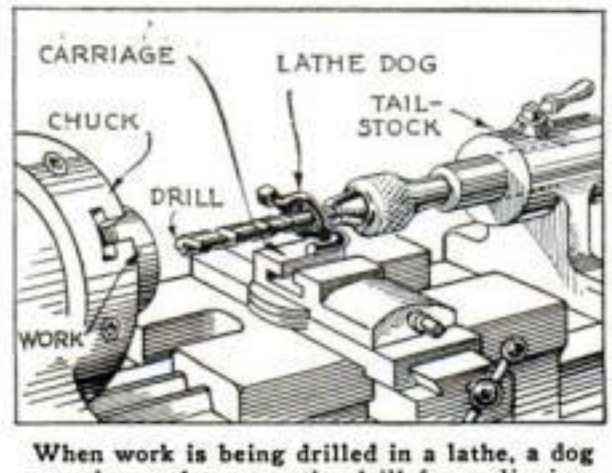
HINTS ON GETTING THE MOST FROM A DRILL

Poor results in drilling in the lathe are often caused by the slipping of the drill in the chuck. Slipping not only tends to make the drill run out of line, but it is almost certain to score the shank; and if the slipping continues for any length of time or occurs often, it will eventually render the drill unfit for accurate work.

When a drill does slip, inspect it carefully before returning it to the tool crib. If the shank is scored, remove the marks with care either by grinding or with a file. Be sure, however, not to make the shank flat at any point.

As soon as you find that a drill tends to slip, attach a lathe dog to the shank and allow it to bear against the tool rest carriage in the manner illustrated below. This is a simple and effective remedy.

Never force a drill, always use plenty of drilling compound, and be sure to check the clearance angle now and then. Also, have the drill or the work revolving while you are removing the drill from a hole, as this will keep the chips clear of the point.—Norris A. Clark.



When work is being drilled in a lathe, a dog may be used to stop the drill from slipping.

Old Bill *Says*—

After a hole has been bored for reaming, it takes only a minute to chamfer the edge slightly at 45°. The reamer will then cut more accurately.

It is a good habit occasionally to take a light cut off the faceplate of your lathe.

Do not try to sharpen a tap with a soft, coarse wheel; use at least a medium wheel for grade and grain. And whatever you do, always maintain the original contour of the flutes.

No one would think of shaving with a razor which has not been stropped after honing. It is equally important not to use a freshly ground reamer or milling cutter without first stoning off the ragged edges.

A stubborn milling machine arbor often can be loosened by placing a heavy bushing in rear of the nut and giving it a hard, sliding blow against the nut.

Do not polish your "mikes" or any other graduated tool, even with fine emery cloth; use a piece of felt dampened with gasoline.

from *Apprentice Boy* to *Chief Inspector*

Chief Inspector Feusht using a LUFKIN Inside "Mike" at the Sun Shipyards in Chester, Pa.

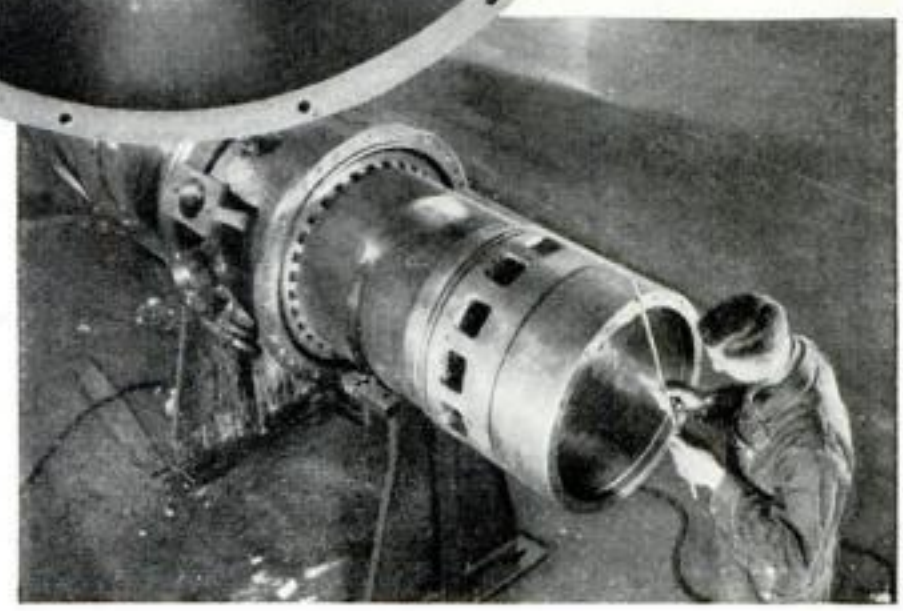
Louis Feusht standing beside the 10 foot cylinder liner, whose inside diameter must be checked in 20 places.

NO Alger story either, this tale of Louis Feusht who started at seventeen as an apprentice for The Sun Ship Building Co.—and is now, at thirty-seven, Chief Inspector of the main machine and engine shops of this company.

In those twenty years one of the biggest things he's learned is the tremendous importance of accurate measurements to the safety of lives and cargoes on the high seas. Today, no engine leaves the erecting shops before every moving part of its giant mechanism has been checked and approved by him. He says: "I've always used the best precision tools on the market. Mistakes in ship building are expensive."

In the big picture, you see him curled up inside of a cylinder liner that goes into a 3000 H.P. Diesel Engine, capable of driving a big oil tanker at 11 knots. That cylinder liner is over 10 feet long, and its inside diameter must be true to .002 of an inch—and checked for that tolerance in 20 different places! That's wholesale accuracy.

Climbing out of the cylinder liner, Chief Inspector Feusht said: "This is awkward work and yet, *with this Lufkin Inside 'Mike', measurements are easy to take because the reading line is always near your line of vision.* It's *the only Inside 'Mike'* I've ever seen *that can be built up at both ends, keeping the head in center,* so you don't have to remove the tool from your work to read it. Then too, the *tubular steel rods,* while *light weight, give the tool,* even when built out to extreme lengths, *the stiffness so necessary for close measurements.*"



Lufkin Inside 'Mikes' have other valuable features. *The head is designed to measure from 1½" up; the lines and figures* are clear, deep, clean cut, hence *easy to read. Handle* is furnished which *can be attached anywhere along the length of the tool, handy for reaching down into slots and small openings, and preserving that perfect balance and feel essential to accuracy.*

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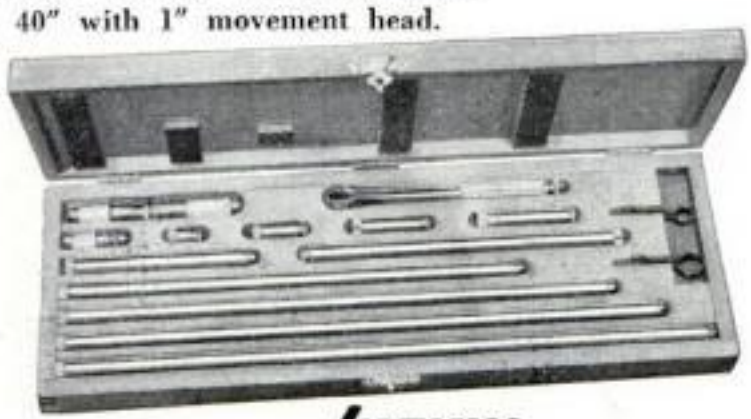
4" to 40" with 1" movement head.



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Turned Walnut Dresser Set

By
JACK ROOD

The assembled dresser set and the three parts of which it consists. Suitable dimensions are suggested in the drawing below, although the maker can change them to suit himself.

FROM the waste ends of some walnut boards, I turned the novel dresser set illustrated. It has two compartments that may be used, either stacked or separated, to hold small pieces of jewelry and various odds and ends.

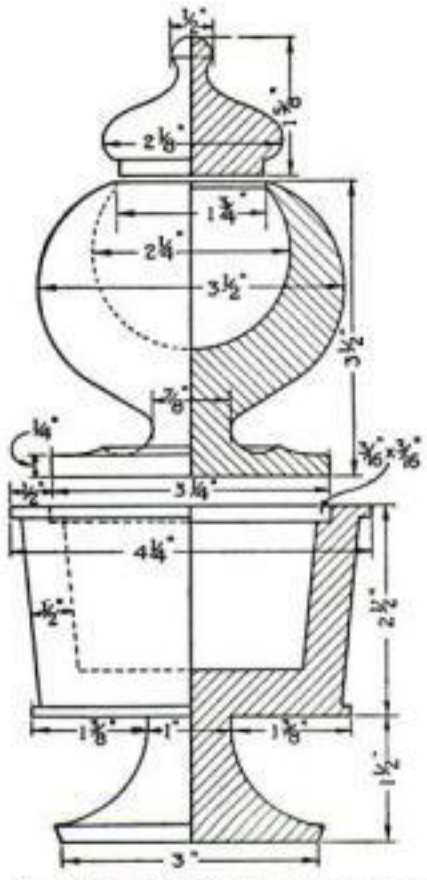
Since the majority of dressers are either walnut or imitation walnut, a nicely finished wooden piece such as this makes an attractive addition to the usual dresser pieces of china, imitation ivory, or glassware.

Rings and small pieces of costume jewelry may be kept in this neat wooden container.

A number of ¾ in. thick walnut squares, 4¼ by 4¼ in. or a little larger, were dressed down, planed on both sides, and glued with high-grade liquid glue to form two blocks, each 4¼ in. thick. These were clamped between the lathe centers until the glue had dried.

The base or lower box, which is 4 in. high and 4¼ in. in diameter over all, was turned by attaching one of the blocks to a small screw-center faceplate; and the dead center was used to hold the piece firm for some of the cutting at the extreme right. Moreover, the screw center was turned into the end grain so the finished base would have greater stiffness at the point where it narrows to 1 in. in diameter. The top inside edge was provided with a rabbet or shoulder to receive the base of the upper member.

The second section resembles a large, hollow, flattened ball on a thin base, which serves as the cover of the lower box. The cover for this upper member is a single small piece, cut as shown.



A working drawing of the dresser set with the principal dimensions.

Each piece was cut, sanded, and finished before removing it from the lathe. First, coarse sandpaper was used; then No. 00 sandpaper and fine steel wool. Walnut stain was applied to the outside only and quickly wiped off with a rag to prevent the color from being too dark. Paste wood filler was then rubbed in by hand wherever needed, and smoothed by means of a soft rag while the lathe was turning.

Finally a coat of clear lacquer was wiped on and touched lightly with a clean rag until nearly dry. In a few moments more pressure was applied and the lacquer rubbed smooth and given a high polish. The boxes were not stained on the inside, but were filled and coated with clear lacquer.

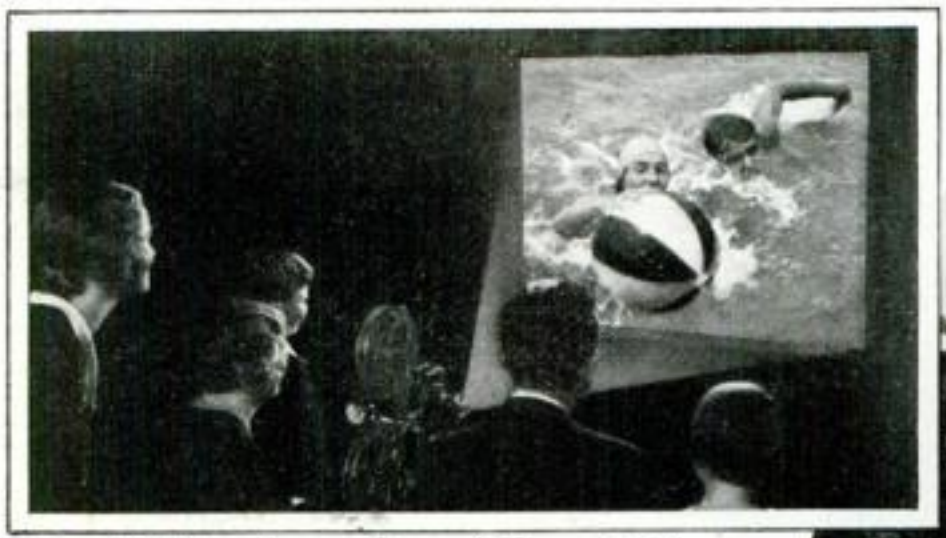
Green or brown felt should be glued to the bottom of both pieces to protect the furniture on which they are placed.

By slightly modifying this idea and using pieces a little larger, you can evolve a smoking set for your cigarettes in the lower compartment and matches in the upper.

ENAMEL in a can that has been opened can be kept from drying up by forcing the lid tightly back into place and placing the can on the shelf in an upside down position. No air can then enter the can, as the enamel completely surrounds the lid and makes a perfect air-tight seal.—W. LESLIE TODD.

Press a Lever...Whir.r.r...

and you've made a movie!



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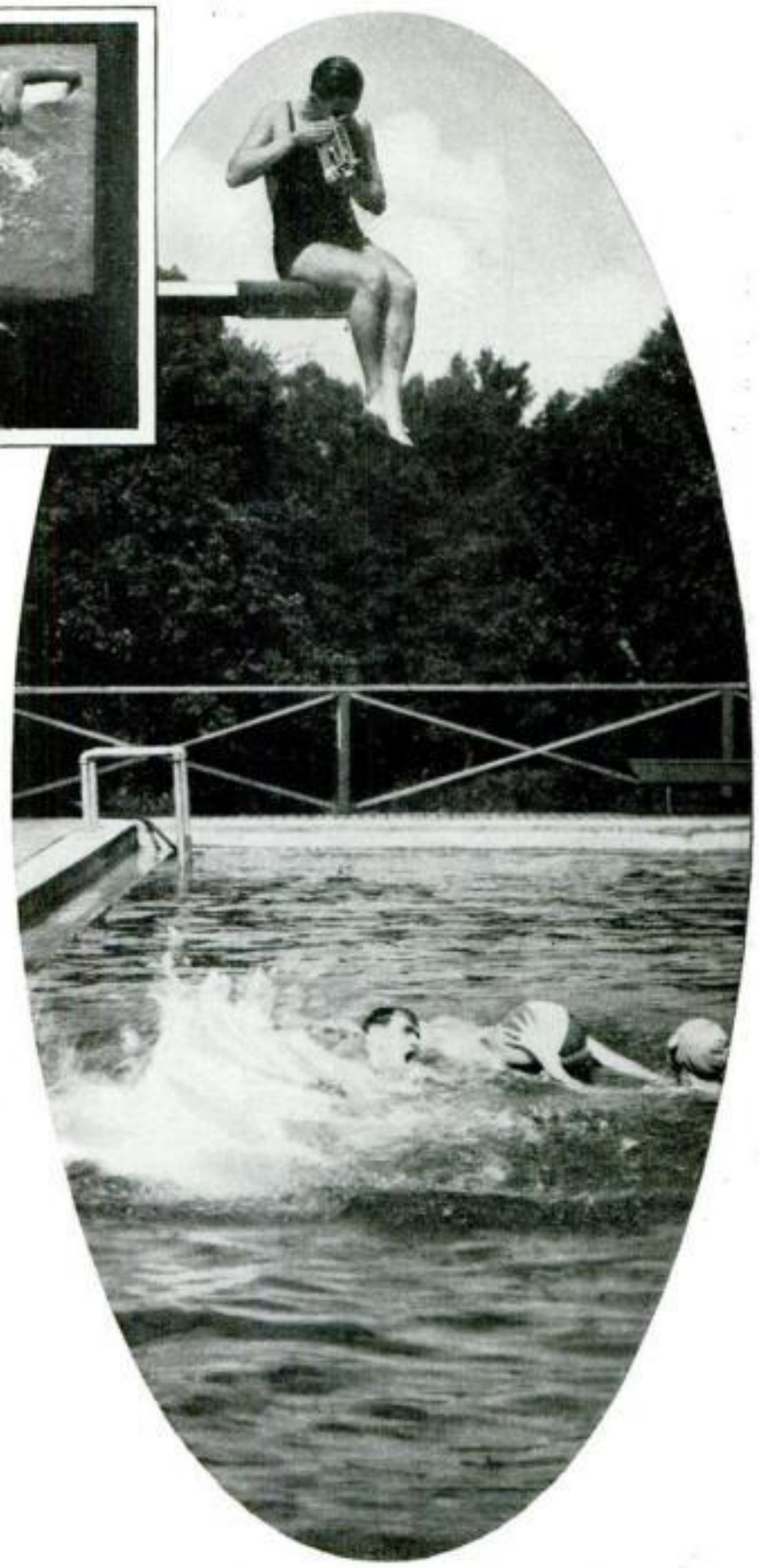

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is the simplest movie camera made, and the lightest that loads with a full 100 feet of 16 mm. film. Requires no focusing, yet gives you clear, sharp movies. Equipped with *f*.3.5 lens and a special attachment for close-ups. Price, including carrying case, $75.

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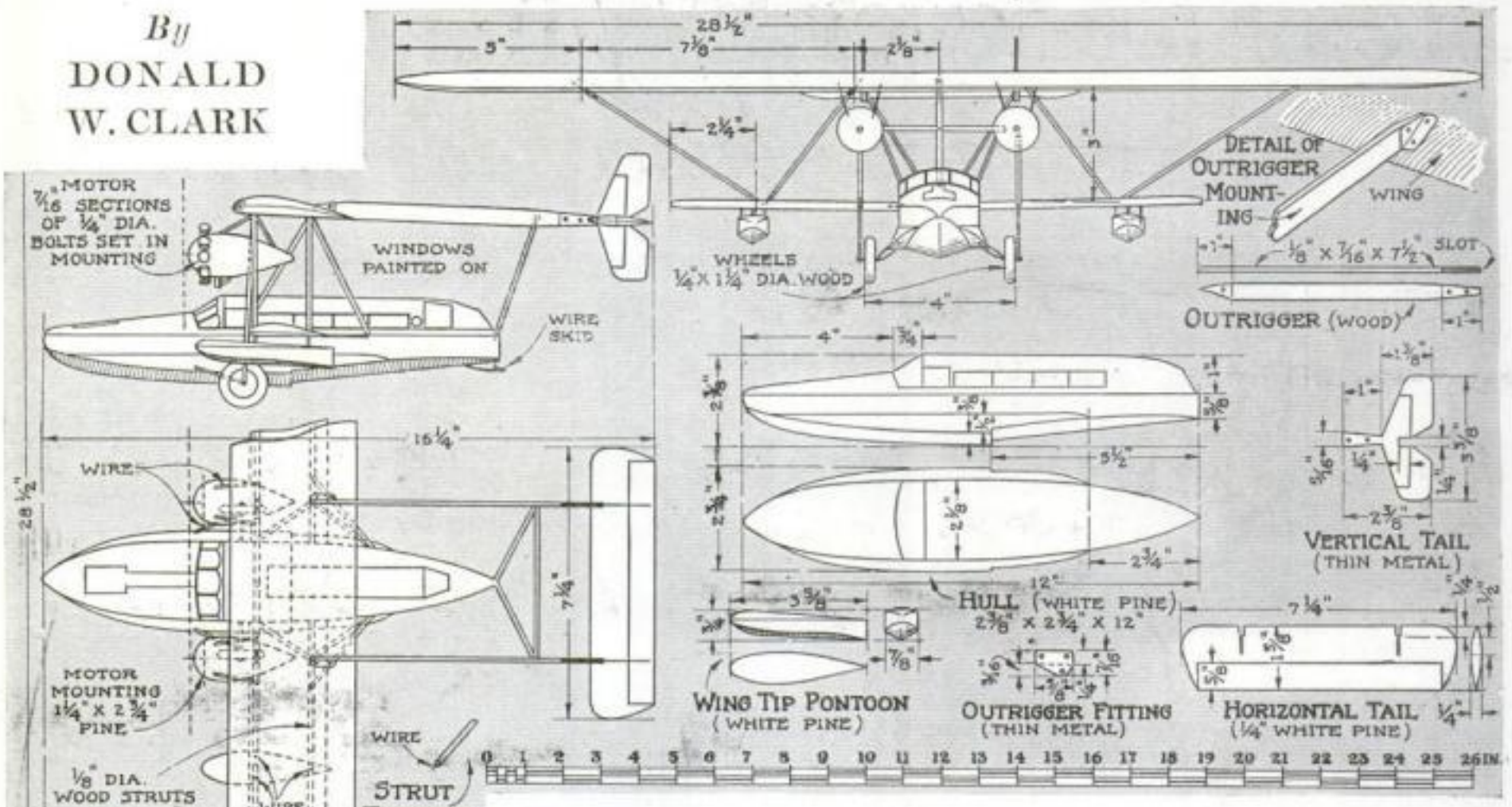
By DONALD W. CLARK



Working drawings for making a simplified nonflying model of the Sikorsky twin-motored amphibian. While all essential dimensions are noted, you can lay out any minor measurements by using the inch scale provided for this purpose.

DOUBLE rudder surfaces supported on an outrigger tail unit make the ten-passenger Sikorsky twin-motored amphibian an unusually interesting subject for those who are building the POPULAR SCIENCE MONTHLY series of simplified scale model airplanes. This article is the fourteenth of the models, which are whittled from softwood.

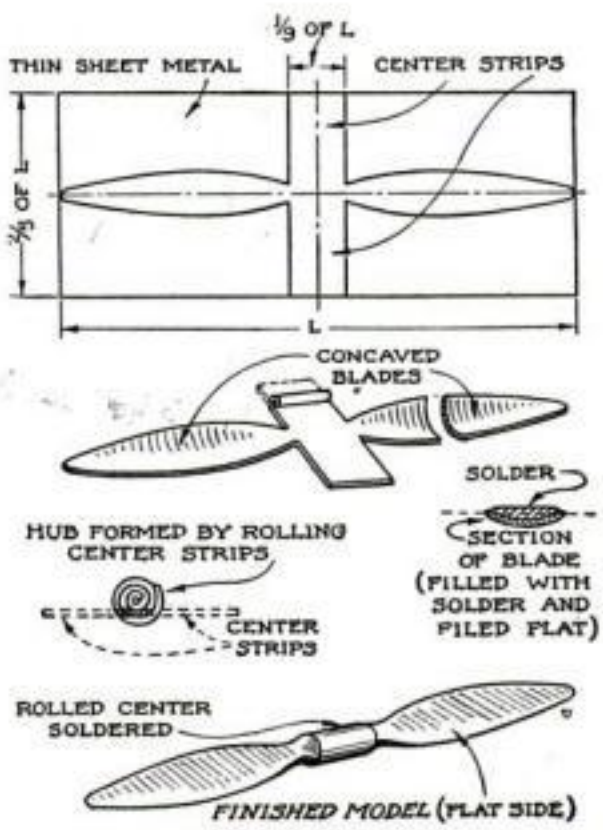
White pine or other softwood is used for the hull, wings, motor mountings, wing struts, pontoons, outriggers, and horizontal tail, while thin metal is used for the outrigger fittings, vertical tail, landing gear struts, tail skid, and propellers.

Cut the hull to the shape shown and attach to it the wings. The lower wing, shorter than the ½ in. thick upper wing, is whittled as a unit from a ¼ by 2 by 12 in. blank and then cut in half and fastened to the hull with small dowels.

The outriggers are fastened to the top surface of the upper wing by means of small metal fittings as indicated.

In painting the model, color the wings, horizontal tail unit, outriggers, and motor mountings cream; the vertical tail units, hull, pontoons, and wing struts maroon; and the wheels and landing gear black. The windows and doors are painted on the hull-like fuselage in contrasting colors.

A SIMPLE WAY TO MAKE MODEL "PROPS"



After the blank has been laid out and cut, the blades are curved, the hub rolled, and the concave surfaces filled flat with solder.

REALISTIC looking metal propellers for whittled airplane models of the type described in Donald W. Clark's articles can be made easily.

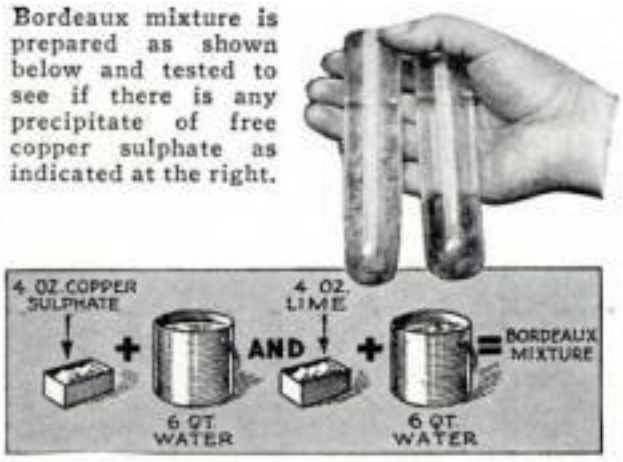
Lay out the propeller on a piece of thin tin or other sheet metal, but do not use aluminum because it cannot be soldered with ordinary solder. Have the width of the metal piece equal to two fifths the length. Mark the horizontal and vertical center lines and locate the hub, which should be one ninth as long as the whole propeller.

Make a blade template and trace the blades accurately on the metal. Then cut the waste material away as shown, leaving only the blades and the two long strips for forming the hub. Begin at one end of one hub strip and roll tightly toward the center; then roll the other strip over the first.

Bend the blades to give them a curve similar to that of the top surface of an airplane wing, and fill in the hollow side with solder until it is flat, and close any cracks or openings in the hub with solder. Drill a hole through the hub and rub the propeller with emery cloth or sandpaper to make it smooth.—KENNETH LLOYD.

How to Save Plants Attacked by Fungi

PLANTS as well as animals become sick, but many of their diseases can be avoided or cured. Under certain conditions, as for instance with the wilt of cucumbers and the black rot of sweet potatoes, crop rotation will almost invari-



Bordeaux mixture is prepared as shown below and tested to see if there is any precipitate of free copper sulphate as indicated at the right.

ably check infection. Rusts, mildews, and blights can be prevented and cured by spraying Bordeaux mixture on the plant. Never spray for diseases after a rain; do this before it rains.

Diseases usually attack the leaves, but sometimes the young growing shoots and occasionally the fruit. The effects of the disease are most frequently made visible by the spotting, wilting, and shriveling of the foliage. Plant infections are often spread from one portion of the plant to another by too frequent watering.

Roses and other plants attacked by mildew fungus, which produces a white discoloration on the leaf, can be controlled by dusting the leaves with finely powdered sulphur very early in the morning before the dew has left the leaves. Dusting with sulphur after the dew has evaporated is useless; furthermore, the necessary chemical action will not take place when the sun is not shining.

The mildew can be controlled on dry days by giving the leaves a spray of starch glue, which covers the fungus and prevents access of air. When it dries, the starch splits off and tears the fungus away from the leaves.

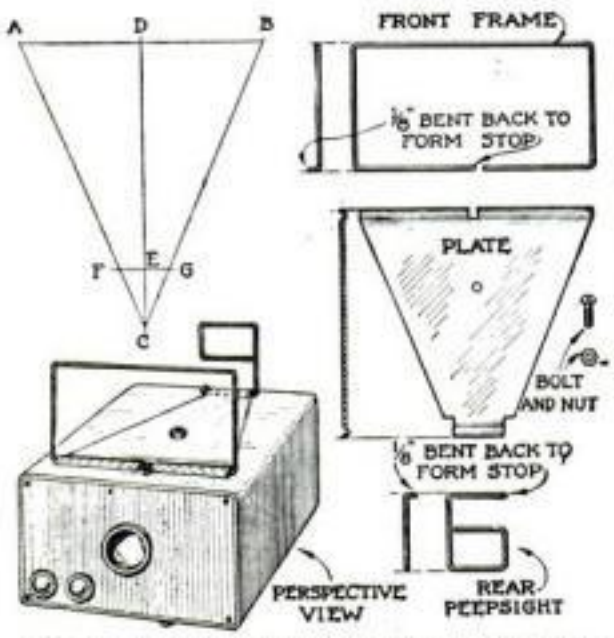
Bordeaux mixture may be purchased or prepared at home. For use as a fungicide, it is made by dissolving 4 oz. of copper sulphate in 6 qt. of water and slaking 4 oz. lime by the gradual addition of 6 qt. of water. Mix both solutions and use. When slaking the lime, do not drown it, and do not use air-slaked lime. Hydrated lime, which has already been slaked, may be used. The two solutions will keep if they are not mixed. When mixed in equal quantities, they should be used within a few days.

The Bordeaux mixture, which is sky blue in color, should have no free copper sulphate, which burns the leaves and may injure them permanently. Therefore, make a test with a solution consisting of five or ten cents' worth of potassium ferrocyanide dissolved in a pint of water. If a few drops are added to the Bordeaux mixture, there should be no brown precipitate. When a precipitate is formed, merely add more slaked lime until the mixture gives a negative test.—H. BADE.

Direct View Finder for a Box Camera

THE amateur photographer who owns a box camera will find that he can take better composed pictures with less trouble if it is equipped with the simply constructed direct view finder illustrated.

In order to make a finder to fit your particular camera, it will be necessary first to prepare a diagram as follows: On a sheet of paper draw the line *CD* (as indicated in the drawings below) to a length equal to the distance between the lens and the film when in place between the two film rolls. Next draw line *AB* equal in length to the length of the picture, and draw line *FG* so as to make *EC* equal 1 in. The figure *ABGF* is a pattern for the sheet iron mounting plate.



The parts that make up the finder, and diagram showing how dimensions are obtained.

Draw another triangle with *DC* the same length and with *FG* in the same position, but with *AB* only as long as the picture is wide.

The frames are bent from heavy wire; the wires from a wire coat hanger will serve the purpose. Bend the front frame so it will be equal in length to *AB* of the first diagram and equal in width to *AB* of the second diagram. A ⅛-in. turn is made at the bottom of the wire frame to serve as a stop when the frame is raised to position (see drawing).

The rear peep sight is as long as the length *FG* in the first diagram and as wide as *FG* in the second. The vertical distance from the center of this peep sight to the mounting plate must be one half of the width of the front frame. Turn the lower end of the wire back to form a stop.

In mounting the plate, arch it slightly and bend over the ends as indicated to take the wire frames. Place the parts on the bottom of the camera and fasten them in place with a bolt passed through a hole drilled in the camera case and in the center of the mounting plate. The nut should be on the outside. Apply a coat of black paint to all parts.—IVAN GROSVENOR.

In use, the camera is held so that the two frames or sights are lined up with the eye.

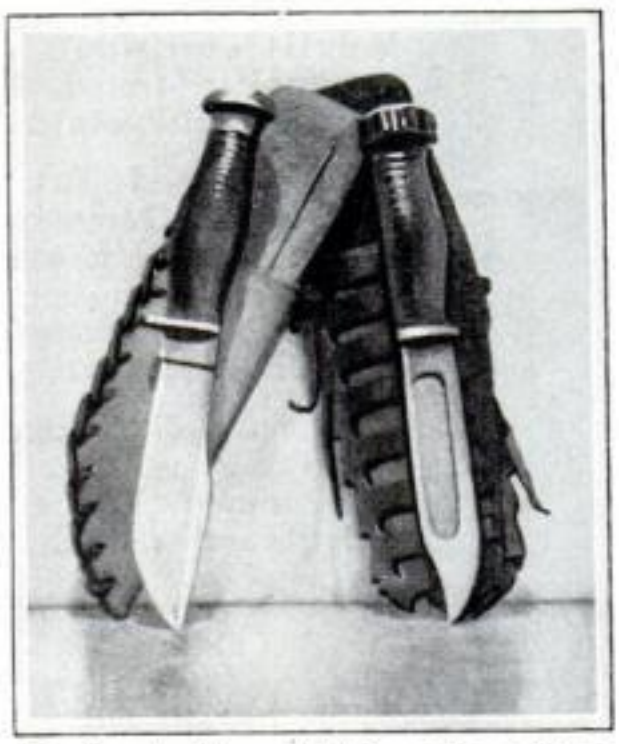
Making a Birch Bark Handle for Your Knife

WHEN the pioneering woodsman needed a handle for his hunting knife, he used birch bark. That was not because it was easy to get, but because it was a better material for the purpose than bone, horn, ivory, or leather.

Examine the bark on any fallen birch tree and observe its condition even after long exposure to wind, rain, snow, and ice. You will then appreciate its durability. Unlike other materials used for the handles of hunting knives, birch bark will not break or chip if dropped, will not rot if exposed to moisture, and will not become slippery when wet.

A birch bark handle is easy to make, too, especially if you have the type of hunting knife illustrated, which has a tang passing through the handle. The first step is to remove the slotted nut which holds the washers in place. If a slotted driver for this purpose is not at hand, file a slot in an old screw driver or in any piece of scrap metal. After removing the nut, take off the cap and the leather, horn, brass, or fiber washers. Do not remove the metal bottom piece or guard.

When obtaining the bark, try to get a piece without holes or blemishes. A sheet 10 by 20 in. will suffice for any ordinary size knife. To prepare the washers, which should be about 1/32 in. thick, cut them roughly to 1 by 1½ in., and use a leather punch to make an elongated hole in the center of each as shown. This hole should be a trifle larger than the hole in the original washers.

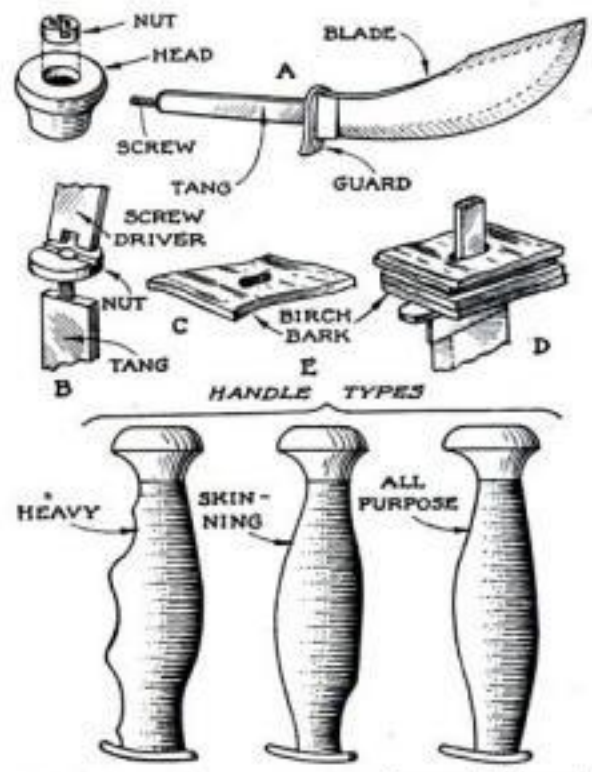


Two hunting knives which the author, a Maine guide, has supplied with birch bark handles.

Place the washers on the tang, one on top of the other, until it will not hold any more. Set the cap in place and tighten the nut, forcing the pieces of bark down as snugly as possible. Next remove the nut and cap and add as many more washers as possible; replace the cap and tighten the nut. Repeat this process until it is impossible to force on additional washers.

With a sharp knife rough out the handle, and use a file and sandpaper to smooth it to the final shape. Three suggested shapes are shown in the drawings.

One or two coats of shellac over the smoothed handle will finish the job, giving you a handle that is not only ornamental but durable.—L. F. MERRILL.



How the washers are cut and assembled, and three types of handle shapes in common use.

COLORFUL SAFETY GATE MAKES PLAYROOM OF YOUR SUNNY PORCH

HERE is an attractive, portable porch gate that will give the children the full run of the sunny porch and still prevent them from wandering off or falling down the steps. It is of sturdy construction, is not easily tipped, and with its gay figures is regarded by the children as a companion—or companions—rather than a barrier between them and adventure. When not in use, the fence can be stored.

Enlarge the figures from the accompanying drawings, transfer the outlines to

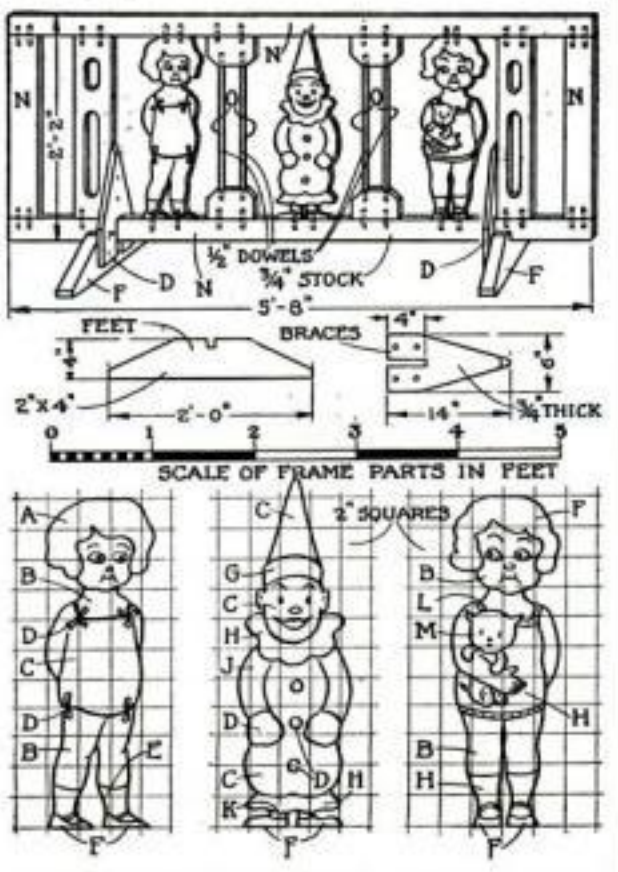
This sturdy gate, being gayly colored, is regarded as a plaything rather than a barrier.

the stock, and cut to the lines with a coping saw or a motor-driven jig saw. Round the edges of the figures and, after smoothing both faces of each with sandpaper, paint them. The outlines and painting appear on both sides of each figure.

The ends of the ½-in. dowels or round stock should be turned or dressed down to ⅜ in. in diameter in order that they will fit in the holes drilled in the base blocks.

All parts are assembled with ⅜-in. dowels with the exception of the feet, which are assembled and fastened to the gate with wood screws.

The following color scheme is suggested: *A* light brown, *B* flesh, *C* white, *D* red, *E* cream, *F* black, *G* dark green, *H* light green, *J* blue, *K* yellow, *L* orange, *M* gray, *N* robin's egg blue, and *O* aluminum or light gray.—CARL O. LANDRUM.



How the gate is constructed. The figures can be enlarged by drawing them on 2-in. squares.

A Trick Bank—*Easy* to Make but *Hard* to Open

By ARTHUR L. SMITH

This is a puzzle novelty devised especially for POPULAR SCIENCE MONTHLY readers by a former editor of *The Enigma* and one of the foremost authorities on puzzles.

The bank itself is a plain box held shut by a curious interlocking framework of wood.

CONSISTING of twenty-four pieces, the adaptation of a Chinese cross puzzle illustrated can be used as a lock for a chest or box of almost any desired size. The rails in the puzzle framework bind the edges of the box and keep its contents well guarded from anyone who does not know the secret of the puzzle. The box can be opened by the removal of only a few of the members, but with twenty-four different ones to choose from, it becomes quite a problem for the uninitiated to find the correct combination.

The small model described is a child's bank. To avoid small fractional parts in stating the dimensions and for convenience in estimating proportions for a larger box, the rails of the model were made ½ in. square. Practically, it is better to make them slightly larger, even for a child's bank—say 9/16 or even ⅝ in. The length, width, and depth of the cuts vary in quarter parts of twice the width of the square rails. The distance from the end cuts to the end is usually equal to the width of a rail, but it may be greater or less. It must, however, be uniform in all cases.

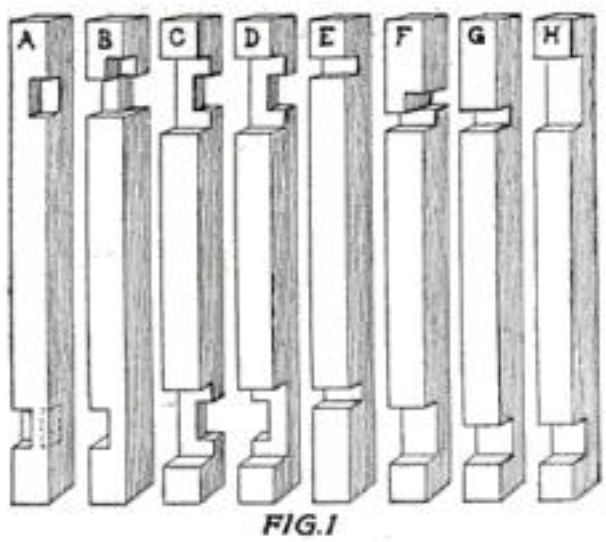


FIG. 1

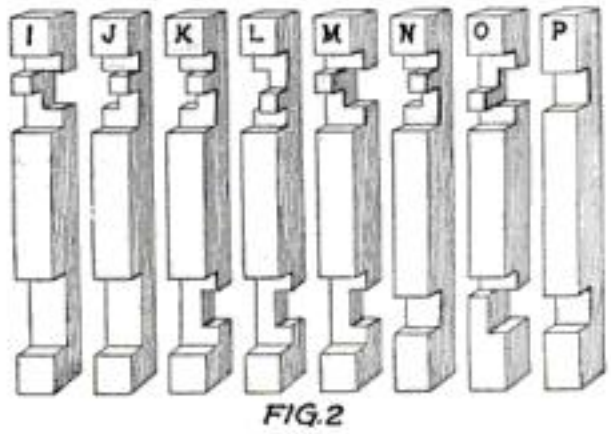


FIG. 2

If the parts are lettered as shown, the assembly directions can be followed with greater ease.

The length, width, and depth of the box, outside measure, will always be the width of a rail greater than the distance between the longest cuts for those respective rails (see Figs. 1 and 2). For instance, in the box illustrated the distance between the longest cuts on the long rails is 3½ in., while on the shorter rails it is 2 in. Hence the box is 4 in. long by 2½ in. square.

The character of the cuts and their dimensions may be easily judged from Figs. 1, 2, and 3. The cut at the lower end of *F* in Fig. 1 is ¾ in. long. The long rails, eight in number, are 6½ in. long; and the shorter are 5 in. long. All of the rails are ½ in. square.

To put the framework together, begin with members *H*, *O*, *F*, and *T*, joining them as shown in Fig. 6. Next add *W*, *U*, and *J* in the order named (Fig. 7). Unless the joints fit tightly, rail *J* will not hold its position until the combination of *G* and *L* is inserted (Fig. 7). This done, rail *S* can be inserted through the square hole in *H* and *G* and pushed back into place. Rail *K* is fitted to rail *F* (Fig. 8). Next, the combination of *Q* and *E* is attached to rail *F*. Care must be taken that *E* is not reversed. Rail *Q* is placed in the notch 1¼ in. from the end. Before this combination is inserted into the hole through *W* and *T*, rail *R* must be placed. To do this, rail *H* is pushed back ¼ in. or so, taking with it rail *O* and permitting *S* also to be moved back the same distance. The long cut on *Q* will allow *K* and *E* to be pushed upward ¼ in. Then rail *R* can be placed on *E* and pushed backward into the notch of *K*.

FIGURE 8 shows the position of the rails as they now appear. The combination of *K*, *R*, and *E* is next pushed down and combination *H*, *O*, and *S* is pushed back into place. Rail *R* can be fitted in an easier way if the joints are loosely cut, but it is best to have them fit snugly.

Members *V*, *I*, and *M* are next added in the order named (Fig. 9). The combination *Q*, *M*, and *E* then can be pushed home. The *C* and *D* rails are now placed so that a square hole through *QU*, *MK*, and *LO* is left. It may be necessary to make their cuts fit a little loosely to get them into position. The rail *C* is pushed upward ¼ in. as in Fig. 10, opening a hole through *S* and *MK*, into which rail *N* can be inserted.

The box (Fig. 5) is placed in the framework at this stage. The cover on the box can be hinged, but if this is done the hinges should be placed on the inside. Obviously, there must be no projections around the edges of the box. The lid of a large box or chest should have a handle to enable it to be removed. With a small child's bank the entire box may be taken out if necessary. In the latter case it will be more confusing to the solver who would open it, to cut the coin slot in the bottom and have the loose cover plain so that the movable rails will be at the bottom of the frame and less likely to be found.

TO LOCK the box in the framework, rail *C* is pushed down into place and *P*, with its ½-in. cuts downward, is inserted through *QU* and *LO* until one of the cuts coincides with the *LO* end cut in *J*. Then *B*, with its ½-in. cut upward, is inserted with this end first into the holes through *IN* and *JP*. When the cut at the *XS* end coincides with that in *C*, the rail *X* is inserted with its ½ by ¼ in. cut facing outward and to the right at the top.

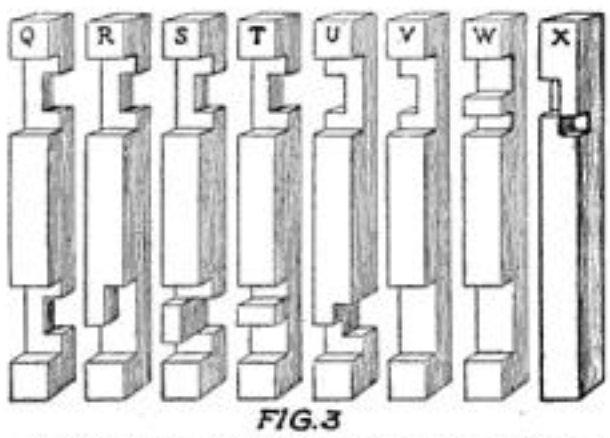


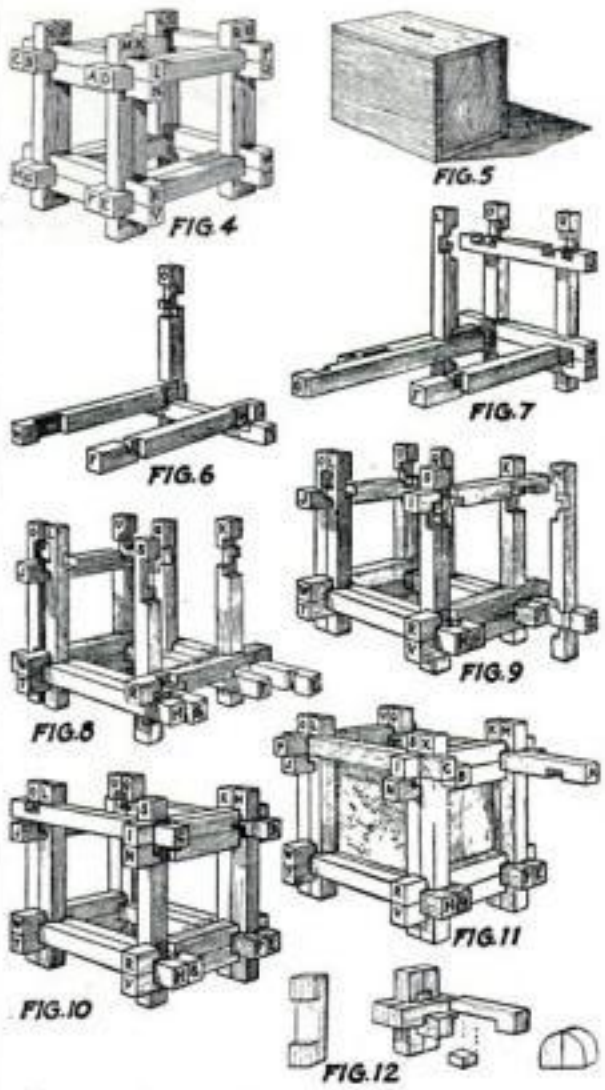
FIG. 3

Make the cuts accurately and plan the matching pieces so they will fit snugly when assembled.

When this cut coincides with *B*, the latter can be pushed into place. Rail *P* is drawn through until its ½-in. cut at the *QU* end coincides with the cut in *J*. Then *C* is pushed upward ¼ in. so as to allow *N* to be drawn out ¼ in. This permits *A* to be inserted with its ½ by ¼ in. cuts to the left, or facing *B*. When these cuts coincide with *P* and *N*, *N* is pushed back, *C* is pushed down, and *P* is pushed into place. The bank is now ready for the puzzle enthusiast.

It will be found that only two rails are movable, *X* and *P*, and these can only be moved ¼ in. Rail *X* may be drawn upward this distance. This feature is introduced merely to hoodwink the solver. Usually finding *X* movable, he will draw it up, thus locking all of the key rails, for they cannot be removed with *X* out of place, even when *P* and *C* are in their proper positions. This may suggest to the reader other means of introducing features that will be misleading to the uninitiated.

To open the bank, *P* is pulled out ¼ in. If a cut about 1/16 in. deep is made on *A*, as indicated by the dotted line in Fig. 1, it will allow *P* to be pulled out too far. Nearly everyone will pull a rail out as far as it will go. In this case, it would relock the key rail *A*, which is



By following the letters carefully, build up the puzzle piece by piece in the manner outlined.

to be removed later, and cause confusion.

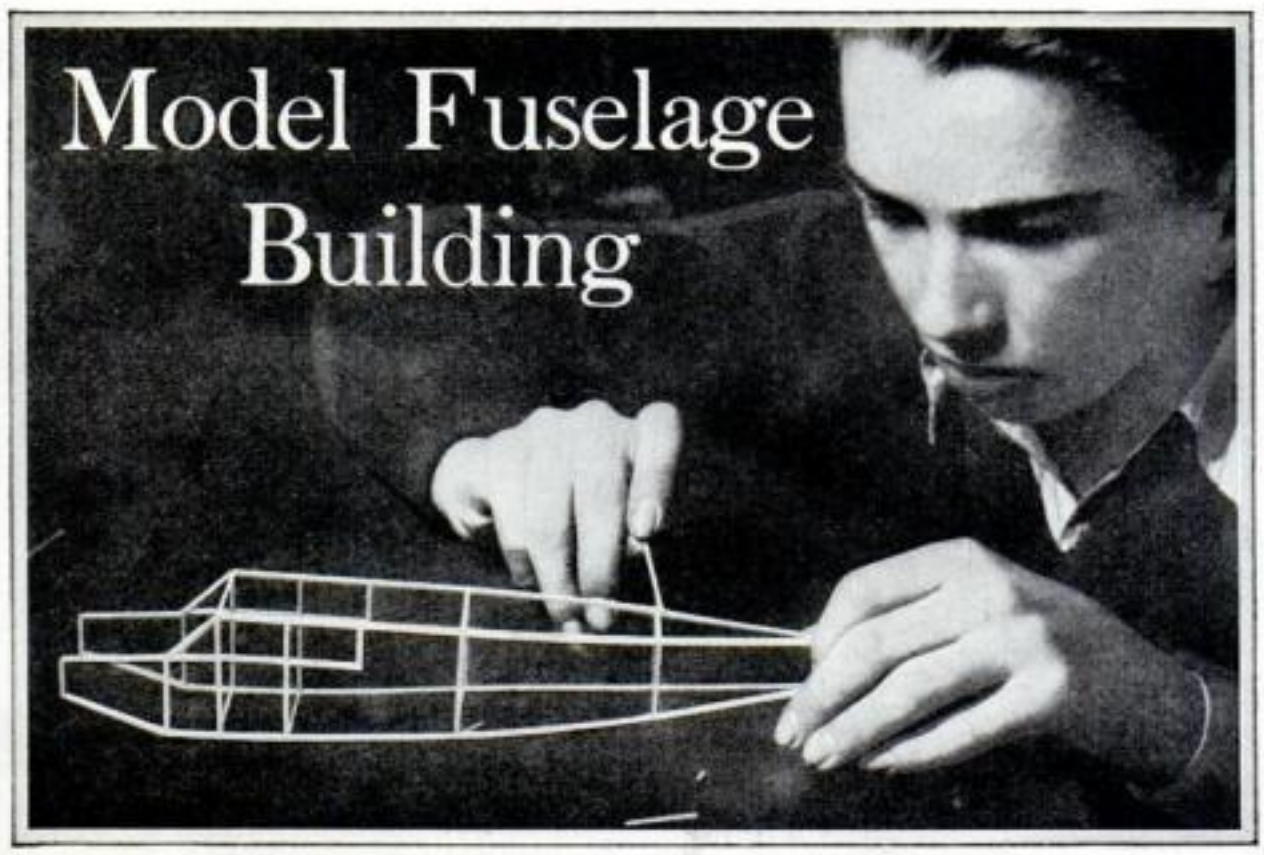
When *P* is out ¼ in., *C* is pushed up and *N* drawn out ¼ in. Member *N* cannot be drawn out further even if a similar 1/16-in. cut is made on *A* as that mentioned, as it would require the deepening of other cuts. Rail *A* is now released. Figure 11 shows *A* partly drawn out at this stage. The bank cannot be opened yet until member *B* is removed. To accomplish this *N* is pushed back, *C* is pushed down, and *P* is pushed through until its ½-in. cut corresponds with *B*. It could be removed, but it is not necessary. Rail *B* can now be drawn out ¼ in. This releases *X*, which is removed. *B* is now withdrawn and the box or cover taken out of the frame. The bank is closed by a reverse process.

As the framework need not be taken apart, many of the elaborate cuts may be avoided by joining the lower corners as suggested in Fig. 12, although the constructor will probably find it just as easy to make it as described. In Fig. 12, the Chinese cross consists of six identical pieces. The last piece is inserted by splitting off the small block at the end and afterward gluing it in place. If neatly done it cannot be detected and the puzzle cannot be taken apart. A cubical hollow space is left in the center. The framework, if made in this way, will require 1 in. long cuts on the following rails: *E*, *F*, *G*, *H*, *T*, and *W* on both ends; *K*, *L*, *M*, *O*, *Q*, *R*, and *S* on the lower ends; and *U* on the upper end. Small blocks may be split off *G*, *E*, *K*, and *M*; perhaps with a little manipulation it might not be necessary in the case of *K*.

After the framework is made the ends may be rounded, if desired, as in Fig. 12.

The rails and box should be stained and waxed to give them a neat and workmanlike appearance.

Model Fuselage Building



By EDWIN T. HAMILTON

TO THE model airplane builder, the proper construction of the fuselage is of the utmost importance. It must have the structural strength to support the motor, motor stick, wings, elevator, rudder, landing gear, tail skid, and propeller; and, on the other hand, being the second largest unit of the model, it has to be designed for lightness.

There are many methods used in constructing fuselages, but the five simple steps to be described will be found a practically foolproof procedure, if followed correctly. These consist of drawing the layout, cutting the material, assembling, covering, and finishing. Occasionally plans for model airplanes are full size, in which case the first step may be eliminated, but they are not usually so.

Figure 1 shows the layout being drawn. It is merely a full size duplicate of the plan from which the model is being constructed. The best view to select is, naturally, the side of the fuselage, as both sides of any fuselage are alike. When round fuselages are being laid out, the round formers should be drawn full size, as well as one of the longerons. If the longerons have varying forms, one drawing of each form should be made. Great care should be taken to insure correct dimensions because the actual work of construction is done with the aid of this full size layout sheet.

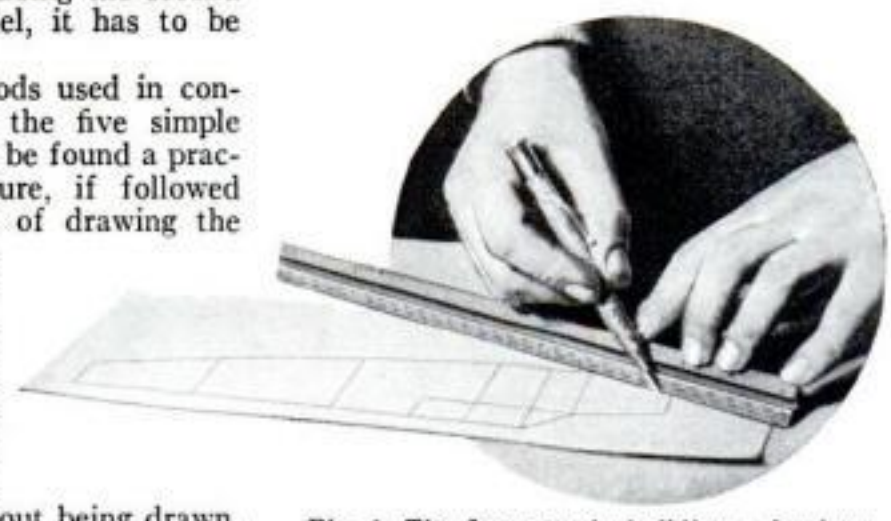


Fig. 1. The first step in building a fuselage is to prepare an accurate, full size layout.

All the material for the fuselage should now be cut. This is best done with a safety razor blade as shown in Fig. 2. Do not cut part of it at a time; cut and finish all. The parts for the two sides, top, and bottom should be laid in separate piles so that they can be

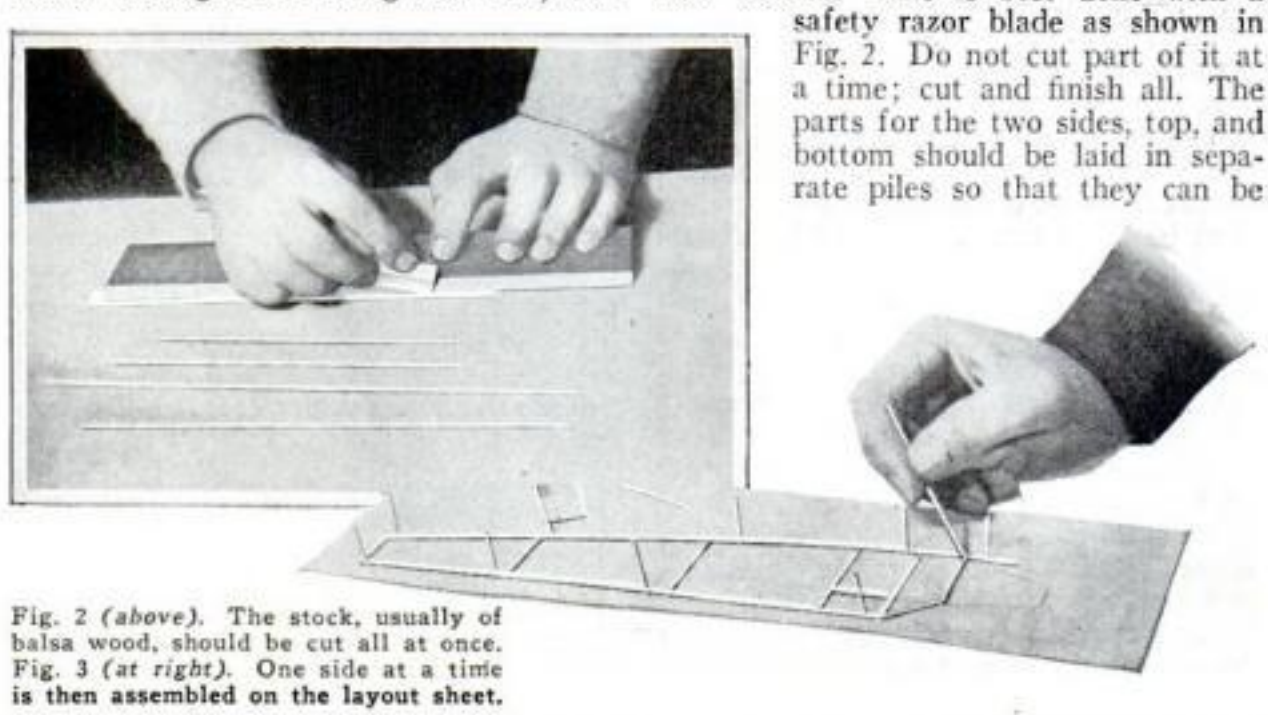


Fig. 2 *(above)*. The stock, usually of balsa wood, should be cut all at once. Fig. 3 *(at right)*. One side at a time is then assembled on the layout sheet.

readily identified when they are needed.

The assembly (Fig. 3) is the third step. Lay each part in its proper position on the layout sheet. Hold the longerons in place with pins, as shown, while the cross braces are slipped between them. To make sure that each part fits perfectly, assemble everything before doing any cementing.

While the longerons are held with the pins, cement the connecting parts to them by applying the cement with the aid of a

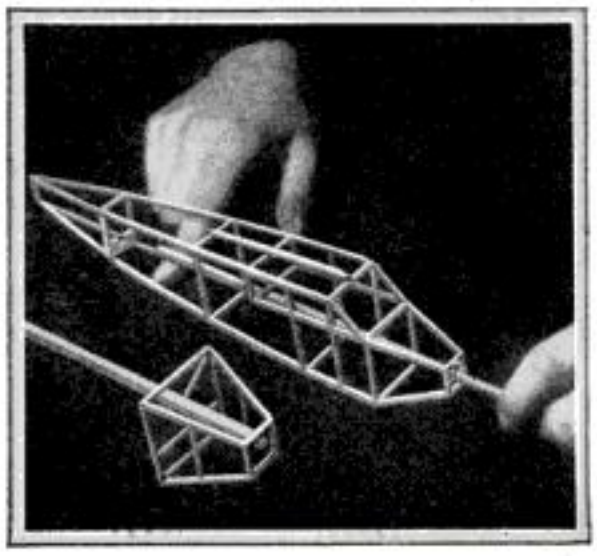


Fig. 4. Two methods of attaching the motor stick so that it can be readily removed.

stick, as shown in Fig. 3. Allow the structure to dry thoroughly in this position. A duplicate side of the fuselage is now made in the same way, using the same layout sheet. This insures both sides being exactly alike.

When both sides have been assembled and are dry, the top and bottom braces are cemented in place. Note this operation being completed in the photograph at the beginning of this article. All assembling should be done on a flat surface. Though the sides of the fuselage may have a fore-and-aft bend in them, they should be assembled straight, and, when the top and bottom braces are ready to be applied, they should be bent to shape. If this method is followed, errors seldom occur.

While the motor stick is not considered a part of the fuselage, its attachments are, therefore it should be discussed here.

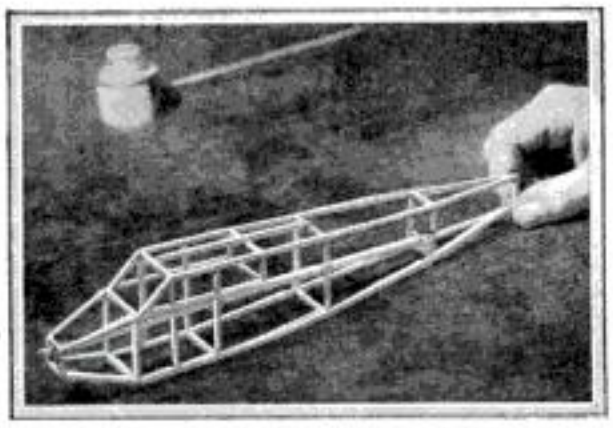


Fig. 5. The assembled fuselage with the motor stick in place and a wing-clip stick on top.

All motor sticks should be detachable as an aid to repairs and winding.

Figure 4 shows two popular types of motor-stick attachments. On the fuselage just assembled, the motor stick fits into a slot made of sheet balsa at the back, which is cemented in place, while its front end is held by means of a music wire clip shaped in the manner of a wing

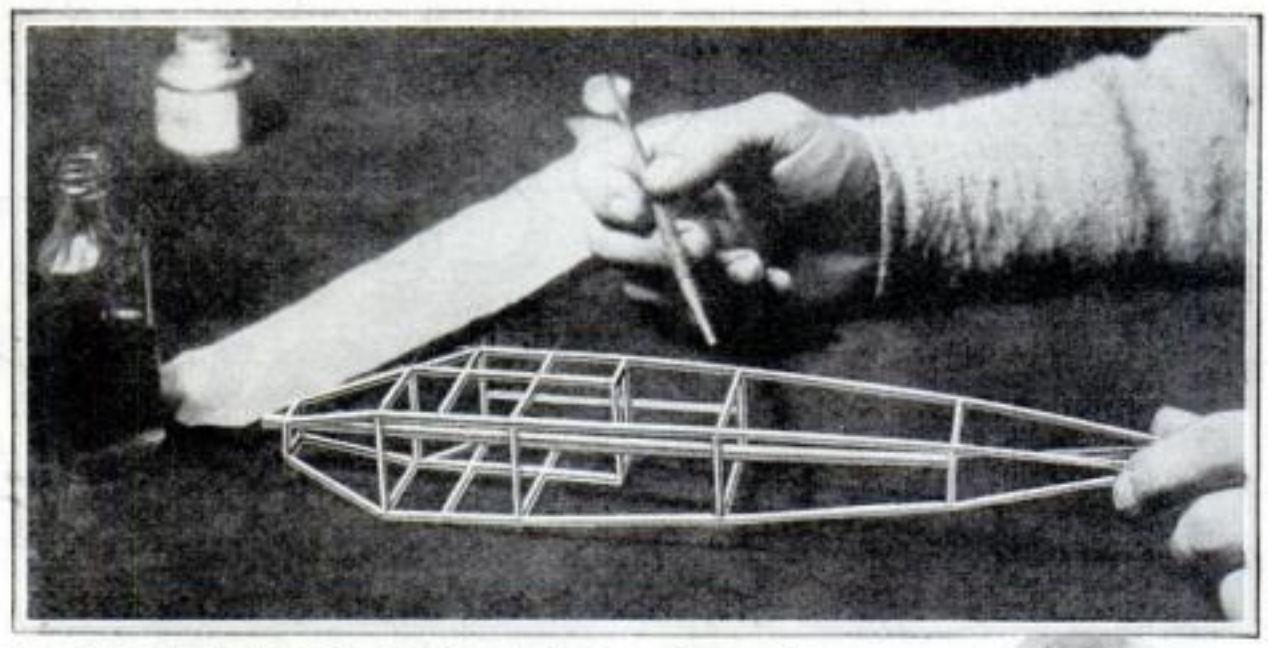


Fig. 6. As the first step in covering the fuselage framework, a coat of model airplane dope is applied to the longerons and braces.

clip. This clip is cemented to the front side braces. While these attachments hold the stick firmly, it can easily be removed, as shown in the photograph.

In the other method illustrated, the motor stick is held in the same manner at the rear, but its front end is cemented in place on a detachable nose piece. When the motor stick is fitted into its rear slot, this nose piece fits tightly against the front of the fuselage and is held either by clips or by two or more slots cut in solid formers.

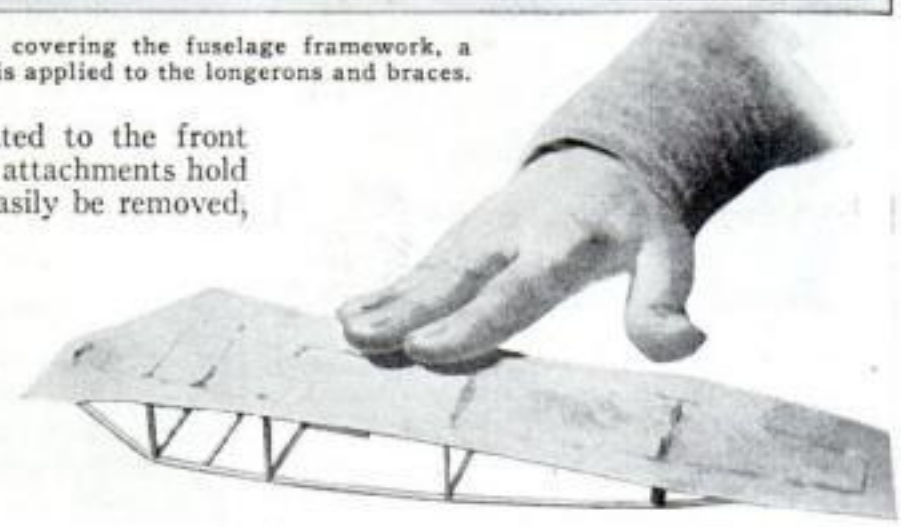


Fig. 7. One side at a time is covered, the paper being pressed carefully on the doped framework and pulled smooth and tight.

In Fig. 5 can be seen the assembled fuselage with its motor stick in place. Note that a wing-clip stick has been added, allowing the wing to be attached to the fuselage with the aid of clips bent from music wire.

Covering is the fourth step in fuselage construction. One side at a time is covered. Cut the tissue to size, which should be a little larger than the side to be covered; then give longerons and braces a coat of dope (Fig. 6) and press the paper over them (Fig. 7). Pull it tight, smooth it out, and allow it to dry.

When the dope has dried, the overlapping tissue is trimmed away. Nail scissors are best for this work, as small curves may be easily cut. Each of the four sides are covered in the same manner.

Colored dope is excellent for finishing a fuselage. The writer has found that the usual colored dope is too thick for safe use on light wing and fuselage construction; it should be thinned to about fifty percent of its original consistency so that warping of the structure will not result.

After the dope has been applied and allowed to dry, the windows and doors can be painted on the tissue, or they may be cut out and thin sheet celluloid substituted, as shown in Fig. 8.

The fuselage of a Stinson-Detroiter has been used for illustration purposes to this point. Figure 9, however, shows the assembly of a Lockheed-Vega monoplane made with bamboo "ringers" or formers.

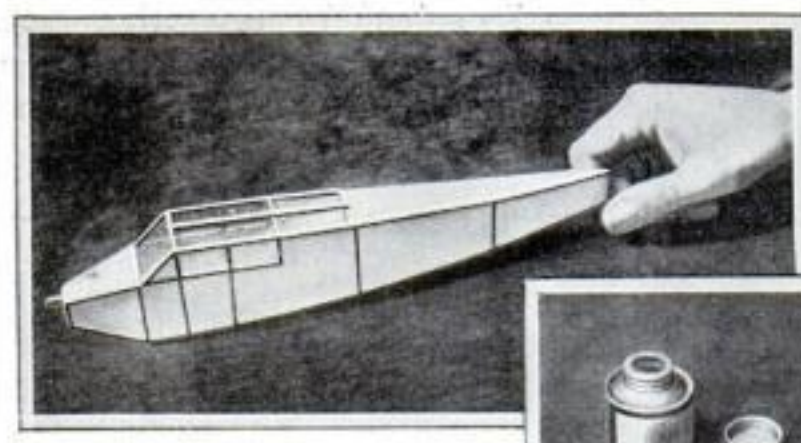


Fig. 8. The fuselage, when covered by the methods shown in the preceding views, has a clean-cut and thoroughly workmanlike look. This is a Stinson-Detroiter fuselage.

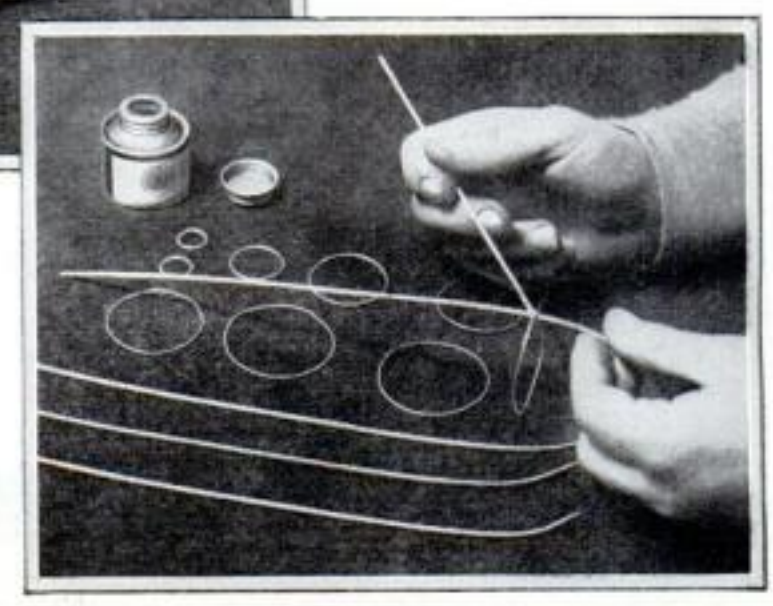


Fig. 9. When it is necessary to construct a round fuselage, such as for a Lockheed-Vega model, the bamboo „ringers" or formers are bent from the full size layout and cemented to one longeron; then the other longerons are attached.

HOW TO MODERNIZE OLD WINDOWS WITH SPRING SASH BALANCES

IN REMODELING or repairing an old house, the handy man often wishes that he knew some easy way to make antiquated, troublesome, sliding window sash without weights work like well-balanced modern sash. He is likely to consider installing pulleys, cords, and weights until he sees how difficult or impossible that would be. There is, however, another expedient—the installation of spring-operated sash balances such as those illustrated. These are to be found on the shelves of all

Spring-operated sash balances are easy to apply to old-fashioned double-hung windows.

large, well-stocked hardware supply stores.

To apply sash balances is such a simple and logical process that most amateur craftsmen will find the manufacturers' directions almost superfluous. The balances are fastened to ordinary old-style window frames by setting the face-plates in the stiles (upright members) of the frame. For the side balances, it will be necessary to cut a mortise in the stud behind each stile to receive the casing of the balance; and if top balances are used, mortises will have to be cut into the head stud. The suspending band in either case is fastened to the edge of the sash.

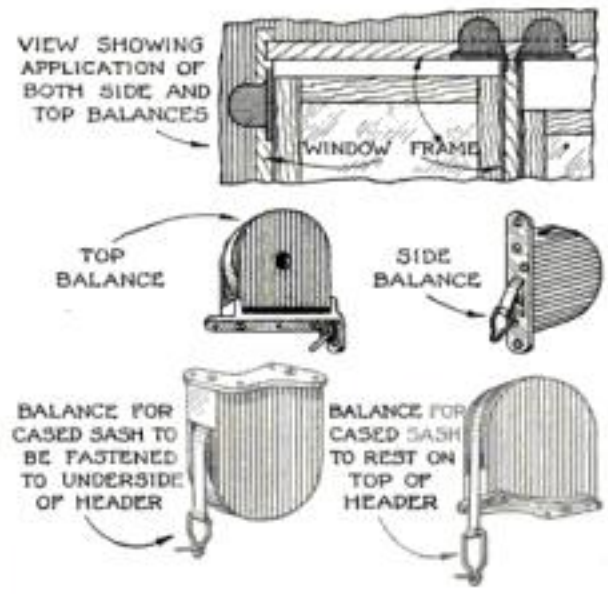
In some of the older houses, it may be more practical to hang only the lower sash rather than both the upper and the lower sash, in which case the balance should be placed so that the band will reach the sash easily.

Spring sash balances prove to be a convenience when a home worker plans to build a summer camp and wishes to construct the window frames for it himself. The frames may be shipped fully assembled or carried knocked down to the camp site and nailed together on the spot. The use of sash balances makes it unnecessary to provide the space ordinarily required for sash weights.

If any double, or mullion, frames are desired, the mullion or division piece need not be wider than the thickness of the two

stiles—in fact, a single 1⅜-in. stile will answer the purpose. When both the upper and lower sash are to be movable, each stile must be grooved for a parting strip as in ordinary sash. The top balances should be fitted so both bands run in line with the edges of the sash, and the head stud should be set high enough to allow the balance case to clear it, no mortises being required in the stud. Similarly, the side studs for a new frame may be set back, if desired, so as to clear the balance casings.

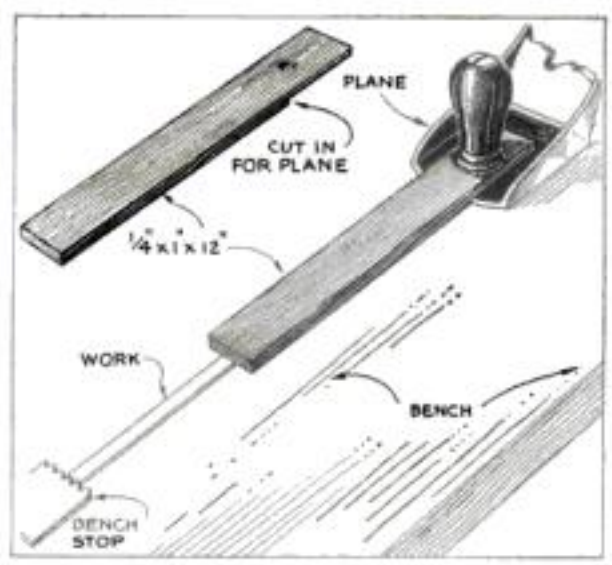
If a window in a narrow space is contemplated, the worker will find that he can save the 2-in. space ordinarily left on each side of the frame for weights, and this will allow the sash itself to be 4 in. wider.—DAVID WEBSTER.



If top balances are used on double windows, the mullion piece may be made much narrower.

PLANING THIN STRIPS FOR USE ON MODELS

OFTEN when a model maker is planing long spars for model airplanes from rough stock, the spar will bend up and snap in two at the beginning of a stroke. To prevent this, I attach a strip of wood as a hold-down or leader under the fore knob of the plane by means of a hole drilled in one end of the wood, as illustrated. It can be easily put on and taken off.—BURL KNUTSON.



A wooden finger attached to the front of the plane holds the strip flat against the bench.

BETTER results can be obtained when boring holes in thin wood stock if the spurs on the auger bit are filed so as to decrease their height. This will prevent the spurs from digging in.—S. T. N.

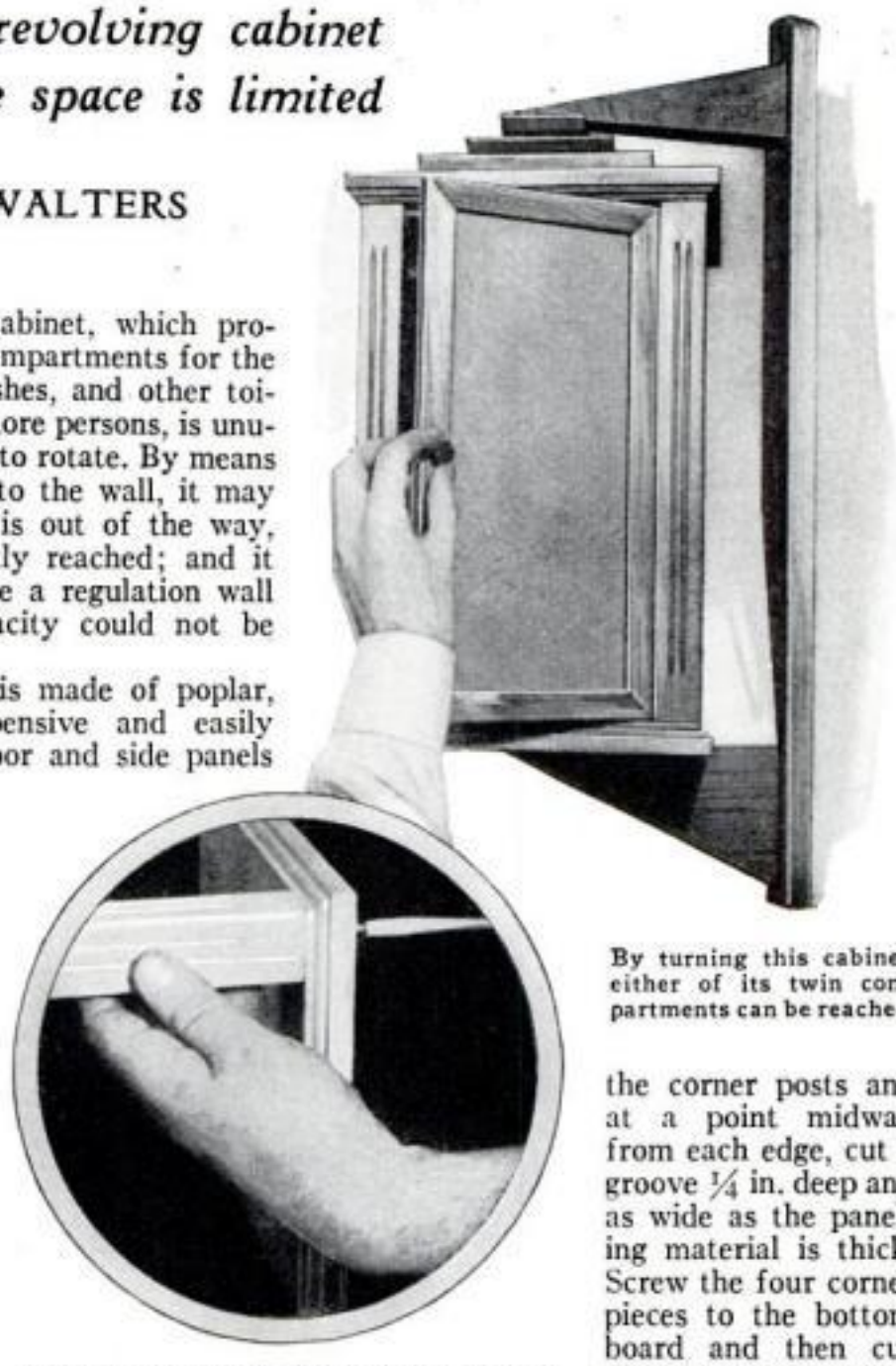
Two Medicine Cases in One

This unique revolving cabinet will go where space is limited

By ERVIN WALTERS

THIS medicine cabinet, which provides separate compartments for the razors, toothbrushes, and other toilet articles of two or more persons, is unusual because it is built to rotate. By means of a bracket screwed to the wall, it may be mounted where it is out of the way, yet can be conveniently reached; and it will fit in places where a regulation wall cabinet of equal capacity could not be installed.

The cabinet frame is made of poplar, gum, or other inexpensive and easily worked wood. The door and side panels and the partitions may be of plywood paneling or of building board. The top and bottom pieces are square, measuring 10 in. on a side. The over-all height of the cabinet, exclusive of the bracket, is 15 in., but this includes a decorative pyramid at the top, made up of square wooden blocks of successively smaller sizes. The corner posts are 1¼ by 1¼ by 13½ in.



Roundhead or countersunk screws are used to assemble top, bottom, and corner posts.

While the cabinet illustrated has two rectangular compartments, and therefore two doors, it could have been built with triangular compartments reached by four doors, one in each side. In that case the size of each section, of course, would have been considerably less.

In the two-compartment cabinet, the sides are installed as follows: In each of the corner posts and at a point midway from each edge, cut a groove ¼ in. deep and as wide as the paneling material is thick. Screw the four corner pieces to the bottom board and then cut the two panels to size and slide them in place. Each should fit snugly at the bottom, where it may be reënforced with a narrow strip nailed inside the cabinet.

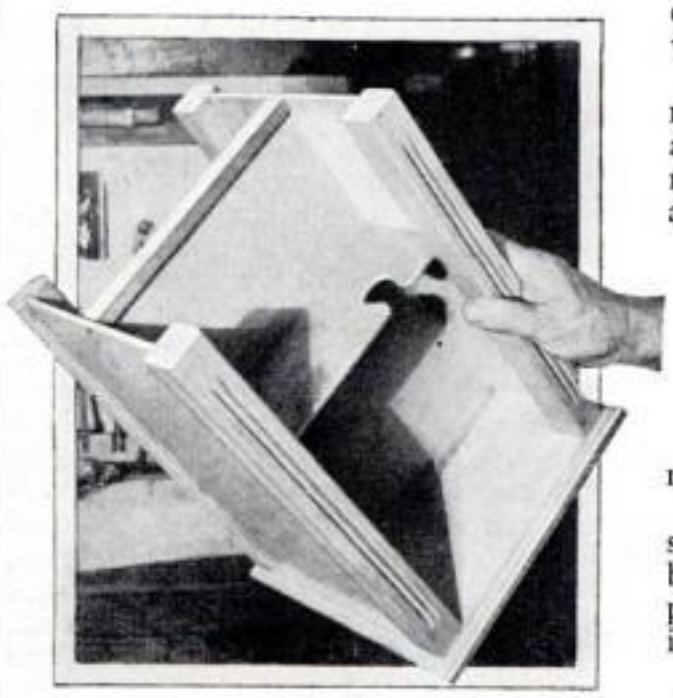
By turning this cabinet, either of its twin compartments can be reached.

Across the middle of the inclosed space, with edges along the vertical center lines of the side panels, install another panel that serves as a partition. Then add what shelves you desire. Each shelf will measure about 3¼ by 8¼ in., although these dimensions are not exact because of the varying thickness and spacing of panels.

Each of the two doors is built up by making a wooden frame with a groove cut along the inside edge of each piece to receive a panel. The corners are mitered and fitted together like a picture frame. If you desire to equip one or both doors with a mirror, you can either mount the glass on the outside surface of the panel or build the door exactly like a picture frame and insert the glass in place of the panel. The latter method is preferable because of its neater and more workmanlike appearance.

The door hinges are pivots made from sections of finishing nails. They are placed before the bottom board is screwed in place. Door knobs should be added and, if desired, ball spring friction catches.

In the center of the top pyramid and of the bottom board, drill a hole to receive a heavy, roundhead wood screw. This

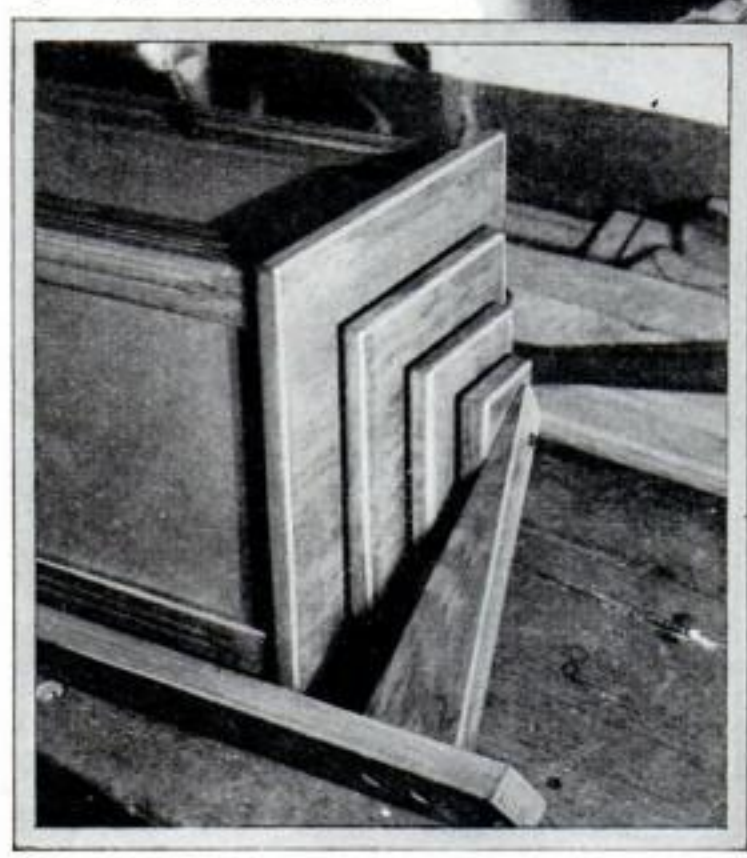


How the interior is arranged. The opening in the shelf is for holding a shaving brush.

screw passes through larger holes drilled in the ends of the triangular arms that support the cabinet. Washers should be placed between the arms and the cabinet to reduce the friction.

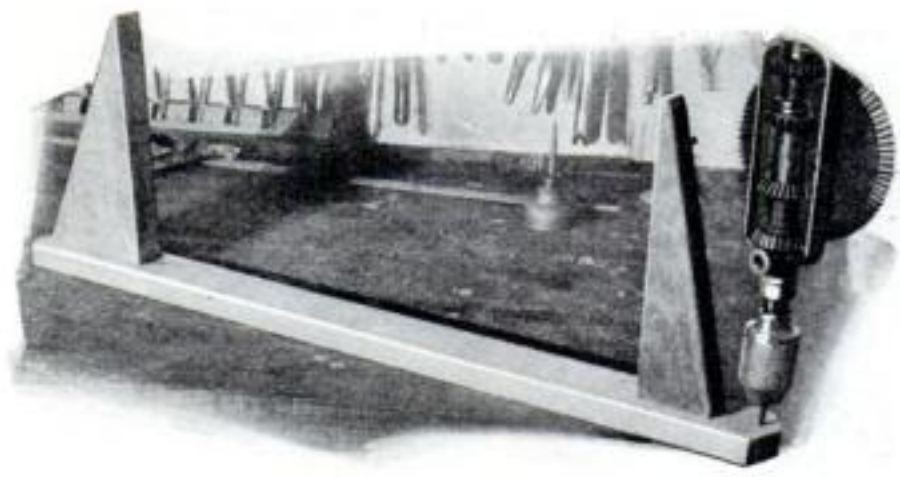
Make the bracket strong enough to support the cabinet no matter how heavily it is loaded. The wall strip may be of 1-in. material, about 2 in. wide and 26 in. long. The triangular arms are cut from 1½-in. stock, preferably maple, birch, or other hardwood; or they are built up by gluing two ¾- or 1-in. boards together. The lower arm, because it supports the weight of the assembly, is the larger, measuring 4 in. at the base. The upper bracket has a base 2 in. wide. Both are 8¼ in. long. Fasten them to the wall strip with heavy screws.

Method of grooving the corner posts on a small circular saw.



View of the cabinet to show just how the pyramid top is made. Note that the upper arm of the bracket must be long enough to allow the corners of the case to clear. Washers are used between the brackets and the top and bottom of the case to reduce the friction.

At right: The supporting bracket must be heavy, especially the arm at the bottom.



In mounting the medicine cabinet, first fasten the bracket in place with heavy wood or lag screws. Then attach the cabinet proper, making the top and bottom screws just tight enough so that it will remain at any position without moving.

The cabinet may be given the conventional white enamel finish or treated in any way to make it harmonize with the color scheme of the room.

SIMPLE NAME PLATE FOR SHIP MODELS

THE problem of painting the name plate on the sides of ship models often presents a serious problem to the amateur. This difficulty, however, can be avoided by the following method.

The name is first neatly lettered with a fine pen on a piece of tracing cloth. By using tracing cloth, it is possible to trace the separate letters from some piece of printing having the style of letters desired. From this a blueprint is made by placing the tracing over a piece of sensitized paper, exposing it to the sun for the required number of minutes, and fixing the print in a fixing bath in order that it will not fade. Next, with a fine pen and India ink, the blue background is blocked out, leaving the letters white. The strip containing the name can then be glued to the hull and a coat of shellac applied.

The same method can be used without having to ink in the background by making the print on a velox type of photographic paper.—H. L. WHEELER.

INSECT MOUNTING BOARD

FOR mounting insect collections, I have found a material which is even better than cork board. Go to a dealer in building materials and buy a piece of one of the insulating boards now on the market. These are soft, and pins are easily stuck into them; also they are quite porous, and it is, therefore, easy to saturate them with poison to protect your collection from live insects.—FRED CORNELIUS.

BLUEPRINTS FOR YOUR HOME WORKSHOP

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. Each subject can be obtained for 25 cents with the exception of certain designs that require two or three sheets of blueprints and are accordingly 50 or 75 cents as noted below. The blueprints are each 15 by 22 in.

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A TURNTABLE FOR FURNITURE REPAIRS

A stand such as this eliminates stooping.

A CONVENIENT turntable stand for holding chairs and other small pieces of furniture to be repaired, painted, or varnished can be made from an old piano stool of the revolving type. It is necessary merely to fasten to it a top 22 by 22 in. or larger made from any available boards.

For my own work, which frequently calls for the repair of rocking-chairs of various sizes, I have gone a step further and made an adjustable framework as shown in the illustration by using the wooden extension slides from a discarded table. These slides often can be obtained for a few cents from furniture repair men and are excellent for making heavy, adjustable frames for various purposes in the home workshop.

In this case, two slides are required, one combination to form each side of the frame. The ends of the frame are two pieces of wood ¾ in. thick, 18 in. long, and the same width as the slides. These are nailed to the ends of the slides, one end of each to an outside slide and the other end to an inside slide. One outside and one inside slide are fastened to the top of the stool in an offcenter position so that when the slides are open the weight will be about the same on both sides and thus avoid tipping.

This framework can be adjusted to suit any rocking-chair. When ordinary chairs or flat-bottomed articles have to be worked on, a plain board top is laid on the frame.—F. U. JUDD.

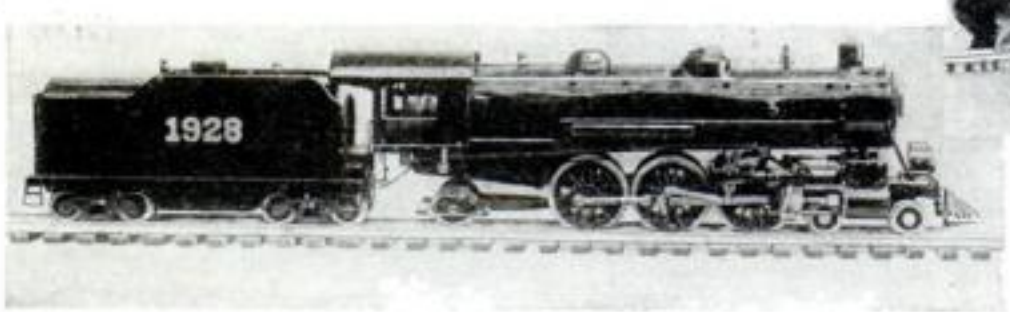
TO REPAIR a small leak in an otherwise usable garden hose, apply an ordinary rubber patch from an automobile tire repair outfit; then wind friction tape over the patch for additional strength.—J. S.

MAKES LOCOMOTIVE MODEL FROM SCRAPS

CONSTRUCTED chiefly of old cans and worn-out automobile and bicycle parts, this remarkably well-made working model of a locomotive was built by Glenn W. Harding, of Martinsville, Va. The specifications in brief are as follows: Height, 6 in. above rails; length, 31½ in.; diameter of driving wheels, 2½ in.; stroke, ¾ in.; bore, 11/16 in.; fuel, denatured alcohol; steam pressure, 10 to 15 lb.; weight, 20 lb.

The ingenious way in which Mr. Harding made use of odds and ends of materials is indicated by the list of parts which went into the construction of this model. The boiler was made of sheet copper taken from an old still, the boiler rivets from No. 14 copper wire, and the boiler flues from a copper gasoline line. The boiler is covered with 3/32-in. asbestos sheet packing for insulation, which is held in place by a tin jacket cut from old coffee cans. The smoke box is an evaporated milk can having part of a shoe polish box soldered to the front, and a slot machine check fastened on this to simulate a number plate.

The cylinders were made from Ford model-T wrist pin bushings; the stuffing boxes, safety valve, and filler caps from auto tire valve caps; the piston and valve rods from wire spokes; the water glass from a broken tea sipper; the steam dome from an old tricycle bell; and the sand dome from a hub cap pressed oval, with two washers soldered on top to represent covers. The driving rods were developed from fender braces taken from an old discarded bicycle.



Glenn W. Harding and his working model of a locomotive made from odd parts.

The small wheels were made from automobile bearings, which were melted and repoured. The driving wheels were taken from a toy electric locomotive. A brass windshield adjusting nut provided the material for making the bell.

The engine and tender frame were built up from ½ by 1/16 in. strap iron of the kind which comes around packing cases. The tender, cab, pilot, and the like were fabricated from galvanized iron picked out of scrap materials.

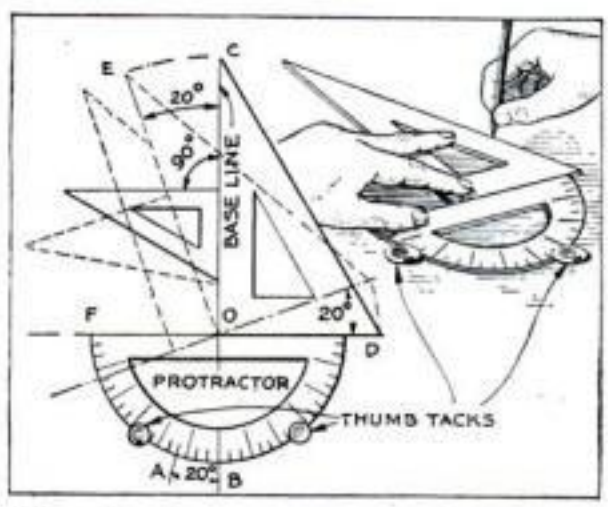
Coming—Articles on Model Railroads

SO GREAT and varied was the response to the model railroad announcement which appeared in the May issue that it has been a difficult task to determine what type of article will meet the requirements of the largest number of readers. Each letter has been given consideration, however, and arrangements are now being made to publish genuinely helpful articles on this phase of model construction.

A TIMESAVING METHOD OF DRAWING ANGLES

WHEN it is necessary to lay out angles accurately on a small drawing board without the use of a T-square, as often happens in the course of mathematical work and various types of designing, a convenient and timesaving method is to mount a protractor on the board by means of two thumb tacks as illustrated and use one or two draftsman's triangles in conjunction with it.

Set the protractor on the base line of the diagram or drawing, push in the thumb tacks where indicated, and set the triangle *OCD* with the side *OD* coincident with the base line. Mark a dash at *B*. Then, to lay out an angle of 20°, for example, slide the protractor around through the desired angle (from *A* to *B*), and angle *COE* will equal angle *AOB*. It is obvious that the triangle may be moved to any point along *FD*, and another triangle can be used with it to obtain any angle desired. This simple kink has saved the writer considerable time on numerous occasions.—GEORGE W. MITCHELL.



Thumb tacks serve as supports for the protractor, allowing it to be shifted quickly.

SAWED-OFF CARD TABLE FOR BEACH PARTIES

OUR most convenient bit of equipment for beach parties, and one that always elicits favorable comment from observers, is nothing more than a card table with the legs sawed off to a length of 12 or 15 in. When these are forced firmly into the sand, the table stands securely, and those seated around it find it a convenient height for meals, games, and books.—J. G. HUTTON.

EMERGENCY PLUMB BOB IS WELL BALANCED

A MACHINIST'S ball pein hammer forms a practical substitute for a plumb bob. All that is necessary is to insert a screw eye in the end of the handle and attach the plumb line to this eye.

A simple plumb bob for work around the house.

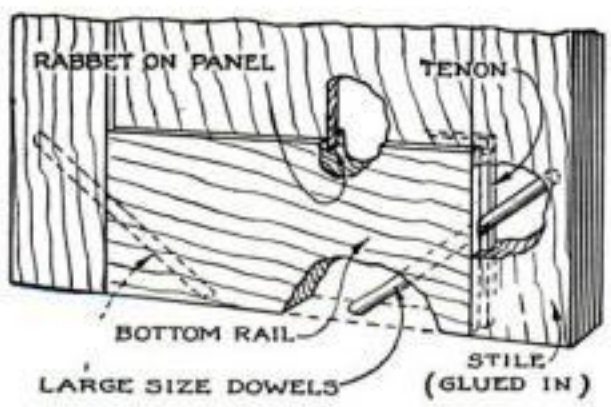
Strange as it may seem, this tool has some of the characteristics of a mercury filled bob in so far as self-balancing qualities go. Hammers of this type are so well designed that there is usually just enough handle to balance the weight of the head. —J. A. NAUER.

STRONG DOWELED JOINTS FOR CABINET DOORS

CUPBOARD and cabinet doors can be assembled quickly by means of the unusual type of doweled joint illustrated. I believe these joints are stronger than the mortise and tenon or the ordinary method of doweling.

The four members of the frame are grooved to receive the panel, and short tenons are cut on the top and bottom rails to fit into the grooves of the stiles or side rails. Then the door is glued, squared, and clamped. While it is still clamped, holes are bored diagonally across the corners as indicated to receive long dowels which are glued in place. The clamps may be removed immediately, which is an advantage if a number of doors are being made or the clamps are needed for other work.

This method of dowelling is not confined to new doors. For example, it makes a strong and simple repair for an old door or any type of framework that shows signs of coming apart.—HOWARD DICK.



When used on cupboard doors, the dowels are visible only on the top and bottom edges.

AFTER losing several photographic negatives, I evolved the plan of placing the negatives under the corresponding prints in my album. The negatives fit under the same decorative corners or in the same slits which hold the prints. Besides keeping the negatives handy, such a scheme protects them.—LESTER PERTLE.

A definite program for getting ahead financially will be found on page four of this issue.

WE NOW GROW OUR OWN RUBBER

(Continued from page 19)

Once the seeds had sprouted, the guayule grew rapidly. Accustomed to shift for itself in its barren native habitat, the hardy shrub fell prey to blights and diseases when grown in the rich soil of the farm. Dr. McCallum had to learn how to get the soil into just the right physical condition to develop in the plant strong disease-resisting qualities.

At once he was harassed by another problem. By irrigation, he could hasten the growth of the guayule and bring a large spreading shrub to maturity in a short time; but as the luxuriance of growth increased, the rubber content fell off to the vanishing point. A four-year-old range shrub yielded about fifteen percent of its dry weight in rubber, but the irrigated plant gave only four percent.

MANY range bushes five years old weighed only one pound, but contained a large amount of rubber. Dr. McCallum's cultivated guayule weighed as much as twenty pounds, but contained almost no rubber.

But he was not to be baffled by the plant's eccentricities. In 1913 and 1914 he set out, in southern California, over a million plants grown from mixed seed from Mexico. Later a much larger number of plants was grown in Arizona. These myriad shrubs were catalogued and card-indexed, classified, selected, and reclassified. Out of this enormous number of specimens, only ten strains were chosen as commercial producers.

Meanwhile, new difficulties arose. In the nursery, the young plants throve, but when transplanted to the field they refused to take root again.

More analysis, more research. Study by the botanists at length revealed that, while the young guayule has a long, deep tap-root, with almost no branches, it later develops a branching root system that enables it to take advantage of the short, infrequent showers of its native region. The plant secretes most of its rubber during the dry season, when it lies almost dormant, little being stored up during the growing period. By patient, intensive culture, Dr. McCallum finally developed a plant whose period of strong root development coincided with the transplanting season, so that this work could be done by machines, without injury to the roots.

In twenty years of research, Dr. McCallum has wrought marvelous changes in the wild Mexican shrub, completely domesticating it and at the same time raising its rubber content amazingly. Some specimens grown in the nursery have yielded as high as forty-five percent of their weight in pure rubber. The undesired resins, which Nature supplied to the guayule plant as a sort of dressing to heal its wounds, are reduced as much as forty percent by simple dessication of the plant before it is milled.

THE vulcanized rubber has a softness of texture not found in the rubber of the tropics, yet specimens have been obtained with a tensile strength of 4,000 pounds per square inch. The improved strain produces in two years as much rubber as was stored by the wild plant in four. Dr. McCallum is now learning how to harvest the shrub at the fourth year and to get the guayule's big root system to resprout, making possible several repeat crops at two- or three-year intervals.

While he has been engaged in this revolutionary experimentation, chemists, peering through high-powered microscopes, analyzed the juices of the guayule bush and classified them as a "colloid" substance—that is, a suspension of countless minute particles, each a microscopic ball of rubber. From knowledge of the behavior of colloids, they predicted that these tiny bits of rubber could be squeezed together into large grains which could be separated from the woody fibers of the plant.

This discovery has provided a basis for the production of guayule rubber without the application of costly chemicals and complicated processes, and has helped to make possible the complete mechanization of rubber manufacture.

ON THE California guayule plantation where the Mexican weed is being cultivated on a huge scale, machines perform every operation from planting the tiny shrubs, six rows at a time, to gathering the mature bushes, extracting their rubber content, and compressing the finished product into sheets and slabs for shipment.

Devices much like vacuum cleaners suck up seeds for planting in the twenty-five-acre nursery, where the guayule bushes are started under the supervision of experts. Tractor-drawn mulchers prepare the top soil, making ready for the mechanical seeder which next passes over the beds, scattering the minute grains, so small that 28,000 of them weigh less than an ounce.

When water is needed, overhead sprinklers cast a gentle spray over the seedling plots. By transplanting time, the tiny shrubs have large, strong roots. A mechanical cutter clips their tops. Next comes a machine that digs the plants up bodily. Another machine sorts and boxes them, 5,000 to the bunch.

When the guayule has reached an age of four years or more, power-driven plows strip the bushes bodily from the ground and stack them in piles. Mechanical beaters flail the dirt from the roots, and the plants are allowed to dry out. Then harvester machines pick them up, chop them to shreds, and blow the bits into trailing trucks.

In the mill, automatic elevators, endless distributing belts, and revolving screw conveyors carry the chopped guayule through a series of crusher rollers that gradually reduce it to a pulp. Water helps to break down the fibers of the wood. In great wooden tubs half the height of the factory building, the pulp is held until most of the waterlogged wood has settled to the bottom. Then it is run off into hydraulic chambers, where steam and pressure together waterlog the cork particles of bark, which sink to the bottom, while the rubber floats to the top.

SKIMMED off, scrubbed by rubber-coated lead pellets the size of golf balls, squeezed through wringers, and dried in vacuum chambers that remove all but one percent of the water, the minute rubber grains are ready to be blocked into slabs. A hot press, exerting a pressure of 2,000 pounds to the square inch, does the rest, and the finished rectangular cubes are packed into pine boxes for shipment.

The successful production of rubber on American soil may prevent another world monopoly such as that which a few years ago forced the price of rubber to almost prohibitive heights. At the present record low price of crude rubber, no operators can hope to make money; but officials of the American Rubber Producers, Inc., under whose direction the Salinas plant is run, expect to make a reasonable profit when a normal market exists.

If the deadly blight which is the scourge of the hevea tree should sweep through the tropical plantations as it has already done in Brazil, guayule rubber might avert a serious world-wide rubber famine.

WE GOT OUR FACE FROM A FISH

(Continued from page 24)

Packards that sprang from them. Do you see now how it is possible that the shark, in a manner of speaking, could develop into man and stay with us at the same time?

MR. MOK: I see that it could happen, but not *how* it happened. To come back to the face: how did it develop from the hideous mask of the shark into the human countenance?

DR. GREGORY: To understand that, you must first realize that every feature of the fish's face is adapted for helping the fish make its living in the water.

MR. MOK: In what way?

DR. GREGORY: In three ways. First of all, it is streamlined so that it creates a minimum of turbulence in the water and a maximum of ease in slipping through it. Secondly, it is slippery.

MR. MOK: What makes a fish slippery?

DR. GREGORY: It is covered with a lubricant. This is a mucus, or slime, which the fish itself manufactures. The purpose of this jellylike stuff is to dissolve the tiny parasite water plants and animals that otherwise would fasten themselves onto the fish's body, like barnacles to the bottom of a ship, and hinder its movements. We owe our own skin, including that on the face, to the inner layers of the fish's skin.

MR. MOK: A good thing we picked the inner ones, or we would be covered with scales.

DR. GREGORY: There was nothing else for us to pick, as you put it, for the fishes gradually lost the outer layers of their skin, including the scales, when they crawled out of the water and became land-living animals.

MR. MOK: You have mentioned two of the features that helped the fishes to make their living in the water. What is the third?

DR. GREGORY: The third is very important. It is their elaborate system of gills, supported by beautifully jointed arches and levers. This enables the fishes to breathe in the water.

MR. MOK: I know. But where is the connection with human beings? We don't live in the water, and don't need gills. We breathe through lungs.

DR. GREGORY: Here is the connection: In our own heads, a part of the remains of this gill system forms the larynx, the box on which our vocal chords are stretched. Another remnant of it is our thyroid. This is the gland, located right under the Adam's apple, which makes one of the chemicals that regulate our growth. Still other remnants of the gill machinery are our tonsils, and the glands that make the saliva. The larynx, or voice box, is derived from one of the fish's gill arches. The thyroid, the tonsils, and the salivary glands were originally the pockets of inner skin that form the fish's gills.

MR. MOK: Can you prove all this?

DR. GREGORY: Certainly. The proof is this: An unborn baby, in the fourth week of its development, has no larynx, no thyroid, no tonsils, and no salivary glands. Instead, it actually has gill pockets and gill arches, like a fish.

MR. MOK: What becomes of them?

DR. GREGORY: The gill pockets become the child's thyroid, his tonsils, and his salivary glands. The gill arches develop into his larynx; the inner, gristly core of the jaws; and the little bones of the middle ear—that is, the part of the ear that transmits sound waves from the outer shell to the inner ear. As a matter of fact, the unborn baby, in its various stages, offers a very much condensed and blurred record*(Continued on page 122)*

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

WE GOT OUR FACE FROM A FISH

(Continued from page 121)

of man's development from the earliest forms. It has, in turn, characteristics of a one-celled creature, a worm, a fish, an amphibian, a lizard, a hairy mammal, a creature with short legs like an ape, and, finally, a man.

MR. MOK: Why is the record blurred?

DR. GREGORY: Because the unborn baby, in each of these stages, resembles the unborn young of the various animal types, and not the adults. If it resembled the adults, the record would be much clearer.

MR. MOK: Is there any other evidence of our fish ancestry?

DR. GREGORY: Plenty. In an adult, the heart is separated from the head by the neck. The four-week unborn baby has no neck. Its heart is located right behind the "gills," as it is in a fish. Another piece of evidence is that we have the remains of a double skull.

MR. MOK: You mean one head inside the other?

DR. GREGORY: Yes, but not all the way. Many of the early fishes had a double brain box. The main purpose of the inner box was to protect the brain and the nervous parts. The outer shell served as a shield against the water and as a base for the muscles. This is still true in many fishes and in some of the lower animals, such as lizards.

MR. MOK: How about us?

DR. GREGORY: In us (and in the other mammals) the top of the old inner roof has thinned out and is now represented by a membrane, or thin skin, which is the outermost of the three membranes that protect the brain. The base, or floor, of the brain case still is double, and so are the lower parts of the sides of the box, directly inward from the ears.

MR. MOK: Where did we get our teeth? Did we inherit them, too, from a fish?

DR. GREGORY: We surely did. Every time your best girl flashes you one of her pretty smiles, she displays a legacy from the shark.

MR. MOK: Our old friend, the shark, again!

DR. GREGORY: We cannot get away from him. He is the ground plan, remember. Now, this shark was a gangster of the worst kind; a robber and a murderer. Naturally, he had thousands of enemies. To protect himself, he wore a coat of mail. In other words, he was covered with teeth from snout to tail.

MR. MOK: Real teeth over the entire body?

DR. GREGORY: They were real enough, though most of them were small. They were tiny, flat scales with sharp points, called skin denticles. In the skin around the shark's mouth, they became larger and gave rise to the teeth.

MR. MOK: Then the teeth are originally a product of the skin?

DR. GREGORY: Right. They were really enlarged skin denticles. In the beginning, teeth had no sockets. The shark still hasn't any. Its teeth grow right out of the skin inside its mouth. This skin is rolled around over the edge of the jaws onto the inside of the mouth. The shark has practically an unlimited supply of teeth; the tooth-bearing part of its skin keeps on growing them. When some break off in front, others swing up from the rear, like reserves. The shark probably continues to grow them as long as it lives. In the primitive shark, the teeth were merely piercers to grasp and help kill its prey.

MR. MOK: It is hard to realize that these murderous prongs *(Continued on page 123)*

WE GOT OUR FACE FROM A FISH

(Continued from page 122)

developed into our teeth. How did it happen?

DR. GREGORY: In later fishes, especially the air-breathing ones, certain parts of the skin that covered the jaws both on the inside and the outside produced bony plates. Bone, you know, is in a sense nothing but hardened skin. To these bony plates the teeth became attached. Later still, the teeth gradually sank into sockets in the bones.

MR. MOK: As I understand it, everything you have told me so far about the face covers its development from the fish's original food trap.

DR. GREGORY: That is right.

MR. MOK: What of the face as an instrument board? Where, for example, did we get the nose?

DR. GREGORY: Sorry, but I will have to go back to the shark again.

MR. MOK: I am used to it by now.

DR. GREGORY: The shark had simply two open pockets, one on each side of its face. They contained a membrane folded somewhat in the shape of a rosette. These membranes were sensitive to odors in the water, especially that of dead fish. That was the humble start of the feature that is mainly responsible for the beauty of the face of man, and the beginning of the organ that makes him delight in the fragrance of the rose and of the frying breakfast bacon. The openings of the shark's nose were on opposite sides of the face because they presumably acted as guides in the creature's steering.

MR. MOK: How would the fact that they were on opposite sides help it in steering?

DR. GREGORY: Because by turning so that it gets a whiff in both nostrils, it makes straight for the source of the smell. That is one of the reasons that three of our sense organs—the eyes, the nostrils, and the ears—are arranged in pairs. As I said before, they are the receiving parts of instruments of precision. These instruments are really range finders. Because the receivers are arranged in pairs, they get equal impulses only when the source is directly in front of them. The same principle forms the basis of the seismograph, the apparatus used to detect the direction of an earthquake, and of several other instruments of precision.

MR. MOK: But we have our nostrils close together.

DR. GREGORY: That started with the mammals. The reason probably was that the eyes superseded the nose as range finders.

MR. MOK: How did the development come about?

DR. GREGORY: Between its two rather distant nostrils, the shark has a bridge of gristle covered with skin, which completes its streamline contour. This is its snout. The roof of this snout, or false face, corresponds to the bridge of the human nose.

MR. MOK: Where did we get the rest?

DR. GREGORY: Just a moment. The later fishes had a pair of bony lids instead of the shark's gristle-bridge. In the mammals, these nasal bones extend nearly to the front end of the snout. When you get home, take a good look at the face of your dog, and you will see that this is so.

MR. MOK: But where did the tip of the nose come from?

DR. GREGORY: I am coming to that now. In the manlike apes, the nasal bones have become shortened in front. The tip of the nose has begun to form but it is not yet much raised beyond the surface of the face. The wings of the nose are large. As the lips and the sides of the nose drew backward, the tip grew forward and downward. How much it grows *(Continued on page 124)*

WE GOT OUR FACE FROM A FISH

(Continued from page 123)

downward and forward determines what kind of nose you are going to have—Greek, Roman, or plain pug.

MR. MOK: In the beginning of our talk, you said that we used our faces to catch mates. It would appear to me that the shape of the nose had a good deal to do with that?

DR. GREGORY: I would not be surprised. But styles in noses, like everything else, change at different times and in different places. Every Australian bushman village may have its own John Barrymore. I believe that our own ancestors of glacier times had faces that were shaped much like those of the Australian bushmen.

MR. MOK: And what of the lips?

DR. GREGORY: Our remote ancestors, from the air-breathing, lobe-finned fishes to the primitive reptiles, had only a bony mask over their faces. This was covered with tough skin, such as the alligator has today.

MR. MOK: Please don't tell me that I owe part of my face to a crocodile!

DR. GREGORY: You do. The reptiles are the inventors of the beginnings of the machinery that gives your face its expression. You see, all the reptiles have a circular band, a muffler you might say, of muscles around their throats. These muscles are under the control of the so-called facial nerve.

MR. MOK: You don't mean to say that an alligator expresses its feelings with its neck?

DR. GREGORY: Of course not. Expression came much later. In the early mammals, this muffler of muscles has grown forward over the face and around the eyes, but it has not yet reached the place of the future lips. As these muscles grew forward, they dragged along with them the branchings of the controlling nerve, which spread over the face like a vine.

MR. MOK: When did the lips appear?

DR. GREGORY: In the regular mammals, such as the horse, the cow, and the dog. This system of muscles and nerve branches reaches a high development in the manlike apes. They are known as the mimetic, or actors', muscles, because they are the "tools" of the theatrical profession. In all mammals the mimetic muscles and their nerves also extend upward around the ears and scalp. Every one knows how easily animals can move their ears. Among us mortals, only a few gifted individuals have inherited that talent.

MR. MOK: Did we invent the smile?

DR. GREGORY: No. The great apes laugh, grin, and smile, but their "smile" may mean anger. When they raise their upper lip so that they expose their canine teeth, they are angry. Otherwise, it means laughter. As for the "smiles" on the faces of cats and dogs, I suspect that they do not exist, except in cartoons.

MR. MOK: Do the apes kiss?

DR. GREGORY: Not exactly. The mother chimpanzee bends over her baby and touches it with the tip of her lower lip. But it is not a completed kiss. The apes use their lips as touch organs to explore things, especially things to eat, and as a funnel through which they suck fruit juices.

MR. MOK: Where did we get our ears?

DR. GREGORY: The external ear openings appeared first in the lizards. The outward ear is simply a resonator, or tube, to catch sound vibrations. The lower mammals were the first animals that had it. In the beginning, it was just a fold of skin, supported by gristle. In the higher mammals, it was seized hold of by the mimetic muscles, so that these animals can move their ears in almost any direction. The ear shells of certain apes are so much like ours that you can scarcely distinguish them.

MR. MOK: And the eyes?

DR. GREGORY: This time I have to go back further than the shark. The first little wormlike creatures had eyes of a sort. They were merely spots of pigment, sensitive to light, that enabled their owners to distinguish between light and darkness. Like teeth, the eyes are originally a product of the skin. In the primitive sea creatures, they may occur in almost any place on the surface of the body, and sometimes in great numbers. The fishes were the first to have eyes somewhat like ours.

MR. MOK: How do they differ?

DR. GREGORY: Their eyes consist of the same three main parts as ours—the lens; the cornea, which is the horny, transparent skin in front of the eyeball and pupil; and the retina, which receives the images, like the film in a camera. But in the early fishes' eyes, the cornea is flat as a protection against the water and also because a bulging eye would interfere with swift movement by increasing the resistance. The principal difference, however, is that their eyes point forward and outward. The eyes of all lower animals do. Ours point forward but not outward.

MR. MOK: What is the effect of this shift in position?

DR. GREGORY: It gives us our bifocal, stereoscopic vision.

MR. MOK: Have we a monopoly on that?

DR. GREGORY: Oh, no, the early monkeys began the invention. A few other animals, such as the cat and the owl, had a try at it, but it was not very successful.

MR. MOK: Where did our eyelids come from?

DR. GREGORY: The eyelid began as a skin over the eyes of the fishes, but it did not become a sensitive, movable eyelid until the mammals appeared. The shark has a horizontal eyelid which is drawn across the eye like a shutter. You still carry a remnant of it around with you.

MR. MOK: What is that?

DR. GREGORY: The little red spot in the corner of your eye.

MR. MOK: Do animals cry as we do?

DR. GREGORY: You mean weeping, don't you? The tear ducts and their glands made their first appearance in the land-living animals and were developed fully by the mammals. Essentially, it is a lubricating apparatus to keep the eye moist and clean. But the animals do not weep as we do.

MR. MOK: I suppose that finishes the features of the face?

DR. GREGORY: Yes, that covers the face of a man pretty well, unless he has a full set of whiskers. If he has, he got it from the mammals, as he did his hair, his eyebrows, and his eyelashes. But don't forget that a face, whether it is bearded or clean-shaven, handsome or homely, is only one "exhibit" in a museum.

MR. MOK: A museum?

DR. GREGORY: Yes, man is a museum. I will explain that to you in our next talk.

NEXT MONTH: Dr. Gregory will show that the human body is a museum. In tracing and explaining its part-by-part development through the ages, he will take up the fascinating question of Man's descent from the apes, and will offer indisputable proof of our monkey ancestry. It will be an outstanding installment in this gripping series, which is to be continued by Dr. Gregory and other world-famed scientists.

GUS GIVES YOU FACTS ABOUT CAR BEARINGS

(Continued from page 78)

you didn't want to hear a squeak and smell a hot bearing! That old system was the grandpa of all the centralized lubricating systems they use today."

"Even if ball bearings don't seem practical for crank shafts," Joe suggested, "there ought to be some way to get around all that scraping."

"Get around it!" echoed Gus. "Why in another few years scraping bearings will be a lost art even in the finest auto repair shops. That motor is a few years old, as you know. Lots of cars are built today so that you couldn't scrape the bearings if you wanted to. The idea is to machine the halves of the bearing shell so accurately that you can simply slip in new bearings.

"YOU have no idea how much time and development is going into that bearing problem. Do you know that some of the makers are going so far as to finish the bearing surfaces of connecting rod big ends with a cutting tool made out of genuine diamond? The result is a surface that is true round, of exactly the right diameter down to less than the hair out of that fly's eyebrow you mentioned and with a surface as smooth as glass. When you stop to think that many of the cars now have lapped crank shaft journals, you can see we are getting bearings, even in popular priced cars, that are better than the most expensive cars had a few years ago."

"What is a lapped bearing?" Joe inquired. "I know what a lap joint is—one that's laid one edge over the other—but how do you lap a bearing?"

Gus reached for his vacuum bottle of coffee. "Lapping a bearing," he explained, "merely means polishing it with a fine abrasive to give even a smoother surface than grinding. It used to be an expensive process but now they have machines that will lap all the journals on a crank shaft at the same time, using crocus cloth or something similar."

"I still don't see why it makes so much difference whether the bearing is absolutely smooth or not," said Joe.

"That's because you don't understand how oil works in a bearing," Gus stated. "Oil has two qualities that really count in lubrication. One is its ability to stick to steel and form a coating that the steel can ride on. The other is the amount of friction the oil particles develop when they slide over each other. They call that viscosity, or thickness.

"The two features are related because a thin oil generally doesn't stick to the steel quite as well and being thin the pressure squashes it out of the bearing—if it's too high for that oil. You notice that most of the good brands of oil are marked with numbers now. Those numbers really tell how thick an oil is, both cold and hot.

"PEOPLE are beginning to call for oil by number instead of asking for light, medium, or heavy. That's a good sign, because all oils marked S. A. E. 30, for example, are of the right thickness for a motor that uses that thickness of oil.

"When you get the right oil into a bearing," Gus went on, "it forms the proper coating and the bearing works right. If the oil is too heavy it may not get in or if it does, the body of the oil will cause more friction moving the particles over each other. On the other hand if the motor maker specifies S. A. E. 40 oil for summer and you use S. A. E. 20, the oil will get so thin when it gets hot that the pressure may force it out of the bearing. When that happens, the steel rubs on the bearing metal itself and that's the end of the bearing."

Anyone Can Fly a Blimp

(Continued from page 21)

collapse were it not for the twelve balsa wood braces that radiate from the nose backward. In fact, the bag does wrinkle a bit at the rear end of the braces when we're flying fast."

Except in the dive we did not move faster than thirty-six miles an hour, just cruising around so I could get the "feel" of the ship. We passed through little wisps of fog, driven away from the large fog bank by the mounting sun. It occurred to me we were sitting in a car that might rip off. I craned my head out and looked up at the bag. Apparently the car was merely glued on to the fabric.

Smithy laughed at my fears when I asked him about that.

"IF THIS car falls, the whole thing will go boom," he said. "The car hangs from sixteen steel cables passing from the top down through two sleeves in the balloonet. So we really are suspended from the top and not from the bottom of the blimp.

"And," he added, "you needn't worry about this bag leaking and plopping us down on one of these factories. There's about a mile and a quarter of fabric in it, but these panels are put together in two thicknesses. The outer fabric, which resembles in weight and texture the cloth that goes into a fine broadcloth shirt, is impregnated with rubber, forced in under high pressure. The inner fabric, of the same material, is painted with a paraffin solution that will not crack. After the two are sewed together and the bag tailored, the outer surface is painted with aluminum."

"Did you say the bag is tailored?"

"Yes, sir! These ships are tailored to order, custom made. We never have to stretch them into shape. When the panels are put together and the bag 'blown up' it looks just as it always will appear."

The balloonet, Smithy explained, provides a cushion on which the helium rides. When the gas expands an enormous pressure is built up. It is then the balloonet flattens out as air passes out through an automatic eighteen-inch valve. When the blimp reaches its ceiling, about 9,000 feet, and ceases to climb the balloonet lies flat on the bottom of the bag.

Here's how it works out practically. One day, early in the winter, when up about 1,500 feet Smithy stopped the engines to clean out a gas line. During that time the blimp settled about 100 feet. Naturally, as the helium contracted in volume, the bag lost its tautness and became flabby. Under those conditions a pilot cannot control the blimp's elevation and direction. It was then sandbags proved their value. Overboard poured the sand from a single sack, and slowly the "rubber duck" rose until expanding gas filled out the bag again. Then Smithy started the engines and flew on. Had he attempted to fly with the bag flabby and in folds the sudden blast from the propellers might have torn the fabric.

FORTUNATELY for the novice there are no involved controls in the blimps. You can kick hard left rudder or roll the wheel back sharply with hardly even a thrill resulting. Several times Smithy has turned into a wind while flying fifty miles an hour. The *Volunteer* would "skid" possibly three city blocks, to the enjoyment of her passengers, but the cabin would swing very little out from a vertical line.

After I had observed the operation of the ship for half an hour, I decided I could fly the thing.

"'Speed' Holman was wise, too," Smithy observed. Holman, who has flown every type airplane that boasts a landing gear, went up with him one day. Smithy offered him the controls as soon as they had ascended 200 feet. Holman declined, though, and waited twenty minutes while Smithy put the blimp through various maneuvers. When, at last, he took over the controls he flew the ship as though he had been flying blimps all his life.

"Any advice?" I asked.

"Just forget you ever were in an airplane," Smithy said. "Don't pick out some object on the horizon and try to fly the ship by that. Try to 'feel' the blimp for an even keel."

That constituted my only verbal instructions. Smithy took his feet off the rudder pedals and removed his hand from the elevator wheel. He settled back in his seat to enjoy the scenery as it bobbed up and down and swung away from the blimp. Or was it the *Volunteer* that was doing the bobbing?

I glanced at the twenty instruments, gages, clocks, and whatnot, and decided they would be of no help. All I needed to do was to close my eyes, "feel" the ship riding on an even keel, and keep her headed south. Easy. Hardly had I taken the wheel when I felt a tremor that seemed to originate in the nose and slide down the bag to the cabin.

Smithy looked at me, grinning, and soon I understood. We had hit a bump, an up-current of air, and instead of riding through it as a fast plane would have done, the current took us by the nose and pointed the blimp upward at an angle of about fifteen degrees. I rolled the wheel forward to correct the movement, and in a trice we were sliding downgrade at the same angle. Then I understood.

In a blimp you anticipate movements from those slight tremors. You roll the wheel back to climb, and almost before the ship's vertical angle is changed, you roll the flippers back into neutral again. You don't need training to be a blimp pilot; you must be psychic. And after a few attempts I got it, roughly speaking.

Having conquered the up-thrusts and down-drafts, I put my mind to straightaway flight. Toward the southern limits of Los Angeles we flew. I glanced at the altimeter. Eleven hundred feet. Along we sailed. After a few minutes my glance again rose to the altimeter. Thirteen hundred feet.

"What's wrong?" I asked Smithy.

"Common mistake for beginners," he shouted. "Look at the rate of climb indicator."

I had the nose of the ship pointed upward at an angle of five degrees.

"Everybody does that," he said.

CONSCIOUSLY, then, I began to fly the ship at what seemed to be a slight angle of descent. I watched the rate of climb indicator and the altimeter closely and after waggling the wheel back and forth a few times finally achieved an even keel!

Having "mastered" this fundamental I decided it would be great sport to turn the blimp suddenly. In the *B-18*, I recalled, when we turned suddenly into the wind while flying out over the Pacific, the gondola had swung far out to the side. Too far for the comfort of mind of a novice. But the *Volunteer* did not act so.

True, I was flying her only thirty-five miles an hour, but in airplanes when pilots with whom I have flown have "kicked her hard over," pressed the rudder pedal far forward, a violent maneuver has followed. In the blimp there was no "stick" to press over in the direction of the rudder movement, and soon after I had "kicked" left rudder, as the airplane boys have it, we turned gracefully, fairly slowly, skidded possibly 200 feet, and went on in the reverse direction. Nothing to it.

I continued at the controls for half an hour. I nosed the *Volunteer* up, nosed her down, turned left and right, and called it a day. Easy up to this point, but from my experience I realize that blimp pilots need to know much before taking out these $60,000 bags and accepting responsibility for four passengers. They must be weather experts, free balloon pilots, blimp pilots, and they should have the experience of flying heavier-than-air machines as well. The last for comparison, at least.

PLANES and blimps are two entirely different kinds of birds. A heavier-than-air ship must achieve considerable forward speed, from fifty to sixty-five miles an hour, before it will be lifted off the ground. A blimp can go off without any forward speed. The rubber ducks are supposed to so balance the pull of gravity that the pointing of the nose up or down when moving forward will change the altitude.

Airplane pilots wait until one wing sinks lower than the other or the nose tilts upward before correcting the fault. Blimp pilots work ahead of the movements, by feel and a considerable amount of intuition. The car and engines on the *Volunteer* weigh a little more than a ton, enough to keep the bag always right side up. The center of buoyancy is directly above the car.

A vast difference between flying in an airplane 150 miles an hour and enjoying cool thirty-five-mile-an-hour breezes from a blimp. After I had finished my "lesson" Smithy took the controls again and we started in a circle south and east from the field, to swing into the wind and drop down over the wires for a landing. At 500 feet we ran into gusty currents. The *Volunteer* bobbed like a cork on a mill pond. Smithy reached for the second air scoop release. Pressure rose in the bag.

Like an airplane pilot coming in for a landing, Smithy nosed the duck down and slowed the motors. We swayed gently in cross currents. Three city blocks from the field he leveled off at 200 feet. Air speed thirty miles an hour, wind about ten miles an hour from the southwest. That made our ground speed twenty miles.

On the ground the crew of seven had arranged themselves in a big V, nose into the wind, with Walter Massic, the co-pilot, standing at the apex holding a wind sock. Our speed dropped to twenty-five, to twenty. We crossed the power lines. Smithy rolled the wheel forward. Down tilted the nose. Again he leveled off, the car possibly fifteen feet above the ground.

"Say when, Smithy."

"Kick 'em!"

I kicked the plunger, the trapdoors opened, and the two nose handling lines that had been coiled ready to drop into eager hands fell from their places. The crew pulled us down and soon the car settled on the lone air wheel, ready for its great steel dock.

ASBESTOS AUTO BODIES

AUTOMOBILE engineers in England are experimenting with asbestos auto bodies. They have succeeded in making thin sheets of asbestos that will take enamel paints used on motor cars. Asbestos bodies are expected to be safer and lighter than those of steel. They will be cheaper, for dies used in making them can be made in a few days, while steel body dies require months of labor to construct.

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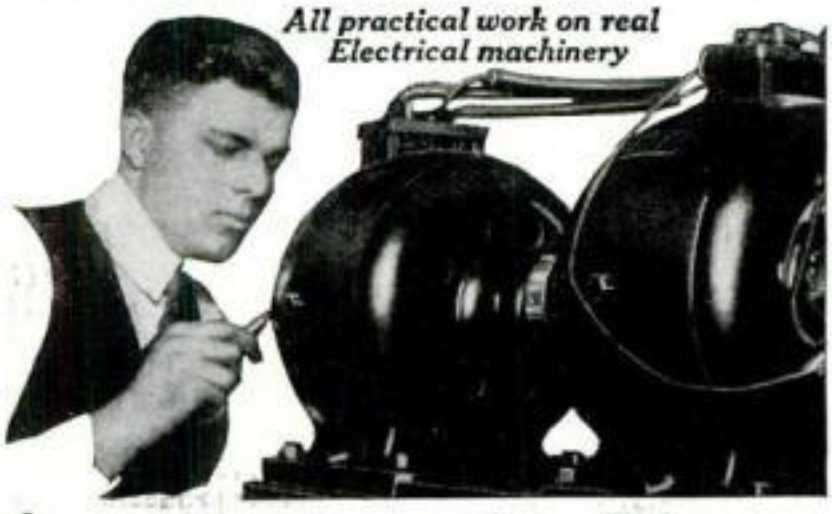

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CAN SOFT DRINKS POISON YOU?

(Continued from page 37)

are of the Government-controlled variety.

All soft drinks contain these ingredients, or most of them: Sugar, fruit juice, acid, carbon dioxide, water, artificial coloring, artificial flavoring. Then, the cola drinks contain caffein, the ginger ales ginger, and the root drinks saponin or some harmless equivalent.

To begin with sugar, of which 250,000 tons are used in soft drinks each year, nothing but the best quality will do for making syrups, because anything else would cause the finished drink to spoil soon after bottling. Its food value averages between 58 and 175 calories, a higher caloric content than that of many foods recommended by nutrition experts. By the action of the acids in the finished syrup, the sugar is changed to "invert sugar," meaning that it is broken down so it can be absorbed more readily by the system.

THAT is why a good drink at a soda fountain not only quenches your thirst, but also renews your energy supply, and does it so quickly. But if sugar generates energy, why does it not also generate enough heat to offset the good effect on a hot day? The answer is that the amount of heat is so small compared to the energy generated that you do not notice it.

The ice in your drink, by the way, helps little to cool you off, and is put into it merely to make it taste better. It is dissipated almost immediately by the heat of the body, which cannot digest anything of a temperature either lower or higher than its own. For some reason, Americans like their beverages either ice-cold or piping hot. This national predeliction is a never-failing source of wonder to European inn-keepers, as returned travelers, exhausted by a vain search for ice water, will testify.

Fruit juices generally constitute about fifteen per cent of the volume of a drink. To them are added fruit acid and color. These fruit juices are said by experts to be just as beneficial in a soft drink as they are in any other form.

Finally, there is the "carbonated water," the essential part of all soft drinks that are not "ades" of one kind or another. Four hundred million gallons of it go into them a year! This is simply water charged with carbon dioxide gas, which gives it its bubbles. In connection with this "fizz water," there has arisen one of the numerous fallacies believed by many about soft beverages.

This is the old "marble dust" story, that still survives. To this day, some people will take you aside, and solemnly warn you against "soda pop" because "it has marble dust in it."

THERE isn't a speck of marble dust in any soft drink, and there never was. But, like many yarns of the sort, it started with a half-truth. The fact is that carbon dioxide gas originally was produced by the action of sulphuric acid upon marble. As gas was released, it was collected and then shipped to the buyer. Word of the process got around, and imagination did the rest.

However, it is possible for carbon dioxide to contain various injurious sulphur compounds when it is made from coke, limestone, or products of the fermentation of low-grade saccharines. Fortunately, gas of such origin gives drinks an unpleasant taste, which eliminates it from use in their manufacture.

Still, there is one danger of which even the maker of syrups himself may not be aware, and which is difficult and sometimes impossible *(Continued on page 129)*

CAN SOFT DRINKS POISON YOU?

(Continued from page 128)

to detect chemically. That is the presence in carbonated water of minute metallic particles from vessels and pipelines used in manufacturing it.

In one case of this kind, the Department of Chemistry discovered 3.3 grains of zinc chloride in one bottle of root beer sent in for examination. A man who had drunk some of the stuff had been made very sick, though not seriously. The only cure for this trouble is to keep the charged water away from such metals as much as possible.

Carbonated water that contains pure carbon dioxide, properly made, is actually good for you. Carbon dioxide is not only stimulating, but kills certain types of harmful bacteria in the large intestine.

THERE are some places where it is never safe to take a soft drink—the carnival, the small circus, and the country fair. These places are infested with hawkers presiding over stands, usually out in the dust-laden air, who invite you to "wet your whistle" from a huge punch-bowl and, more often, a doubtfully clean tin tub. It is filled to the brim with a pale pink liquid in which a few forlorn and tired looking lemons are floating.

Keep away from such stuff. You wouldn't buy a bottle of orangeade that had a cloudy appearance. You would return to the soda clerk a bottle of "pop" in which you saw a black dust particle. But at the fair, all is gaiety and excitement; you don't care!

It is this mental attitude of which the hawker takes shrewd advantage. He makes you pay him several thousand percent on his investment. He makes you swallow enough real dirt from the trampled midway to cause you to fire the cook if you found it in your spinach. He makes you believe this mixture is "lemonade."

He buys it in powder form from houses that sell carnival equipment wholesale. In any carnival trade magazine you will find this powder advertised—not as lemon or orange powder. Oh, no. That would get the wholesaler in trouble with the Food and Drug Administration. It is cleverly advertised as "fruit flavor," and is shipped to the buyer as such. He mixes about two dollars' worth of it with thirty gallons of water from the nearest faucet (or from the buckets used to water the elephants), adds a few slices of real lemon for effect, a quarter's worth of ice, and sells it as "lemonade" at ten cents a glass.

You can readily see that the Food and Drug Administration is powerless to stop this racket. There has been no misrepresentation, misbranding, or mislabeling of a product shipped from one State to another. All misrepresentation has taken place locally.

PROHIBITION, of course, has greatly increased the consumption of soft drinks. But a paradoxical feature of the situation is that each and every one of them contains alcohol. This is because the flavoring extracts are almost insoluble in water, but readily soluble in alcohol. Therefore, alcohol is used to dissolve them, and some of it remains in the drinks. But even if you are a confirmed Dry, you can take your "soda pop" with a clear conscience, for the residue of alcohol is not sufficient to constitute anything approaching a violation of the Eighteenth Amendment and the Volstead Act.

Also, whether you are a Dry or a Wet, you may drink your "pop," or whatever it is you like, without fear for your health. The Government watches out for its purity, and it is to the maker's advantage that it should be wholesome so that you, like Oliver Twist, will come back for "more."

NEW PAINTS FOUND BY CHEMISTS

(Continued from page 52)

a sugar solution, and addition of lead pigments to paints have all been used in the unceasing war with dampness.

Latest developments in paint research, according to Browne, indicate that not only the moisture content of wood but also the character of the wood itself must be combated by choosing the right paint for each job. This problem was studied by the Forest Products Laboratory for eight years, during which eighteen types of wood commonly used in building were exposed for long periods in eleven different parts of the United States.

IT WAS found that paints which stood up well under all conditions on one type of wood broke down quickly on others. As far as the types of woods were concerned, it was determined that cedars and redwood retained paint for the longest and Douglas fir, western larches, and southern yellow pine for the shortest time.

If you want to get the greatest value from your next house painting, science says you must not only consider the kind of wood that went into it, but what part of the tree the wood came from! The manner in which the log was sawed and the planks planed and finished should be accounted for in the application of modern paint in the modern manner.

In the first place, wood absorbs and holds paint because of its porous structure, made up of deep, tiny cells. If a board comes from the heartwood—that is, the older, harder part of the tree nearest the heart—it will resist decay more vigorously than the sapwood, or that nearest the bark. The sapwood, on the other hand, while less durable against decay, will absorb painting oils more readily than its older brother.

Similarly, a board cut from the summerwood—or dark, horny portion of the tree's annual ring—will be found to take up paint oils more readily than the less dense springwood, but paint will not adhere as long to it. There is a greater variation in painting characteristics between the springwood and summerwood in a single board, according to Browne, than there is between average boards of different woods.

From the decorative standpoint, paint has undergone many recent improvements. The development of quick-drying brushing lacquers has led many a housewife to do her own painting.

Color is taking annually a larger part in human life, as an understanding of its use and effect is being gained. It has long been known that light colors stimulate while dark colors depress. Experiments with animals and plants have shown that they react strongly to color, both being aided in growth by those colors which reflect light rather than absorb it. It is now possible, through the use of lithopone or zinc oxide, to paint walls so that they will reflect eighty-five percent of the light that reaches them.

SCIENCE says that some surfaces with which we must live should be restful rather than stimulating. Thus the recent vogue for green tinted blackboards in schoolrooms.

Heat is affected by color as well as light. It has been discovered that radiators painted white yielded twenty percent more heat than those which had not been painted, the darker colors also yielding less heat than white, depending upon their density. Painted tanks containing naphtha were exposed to the sunlight for two hours, and temperature readings were taken. It was found that there was a difference of eleven degrees between those painted black and those painted white.

The growing use of tung oil in paints and varnishes has led to the rise of an entirely new industry in the southern United States—that of tung oil planting and manufacture. Tung oil, until a few years ago, came only from the interior of China. Now it is being produced in increasingly large quantities right here in America.

In Florida, Alabama, Louisiana, Mississippi, and Georgia almost 10,000 acres are planted with some 550,000 trees, as compared with 14,000 trees in 1923. The total value of tung oil used in the United States for varnish and lacquer in 1929 was $14,972,084, this amount being paid for 119,677,718 pounds of the oil.

COMMONEST among the ingredients of weather resisting paints are lead, zinc, and aluminum powder. Beyond the recent development of the latter, few changes have been effected in the composition of these paints except for the proportions in which they are mixed. Real progress has been made by paint chemists in making paints that stick well to wood, but the problem has not been perfectly solved and chemists still ask themselves, since glue sticks to summerwood, why cannot paint be made to do so? In this connection Browne said:

"A coating that would endure indefinitely is probably a vain objective and perhaps not an altogether desirable one, for most people would like to change their scheme of decoration once in a while. The ideal coating for wood, however, ought to remain an adequate protective agent against wood weathering until its appearance is so changed that repainting is clearly necessary, and it ought to wear down uniformly over summerwood and springwood alike, being firmly anchored to all parts of the wood when repainting is done. Flaking from summerwood should be unknown. With such a paint, all wood surfaces would give equally satisfactory service."

Improvements in the manufacture and application of paint will come with time and research. And, as the nation's paint bill grows annually larger, because of an increasing use of paint, the cost to the individual will diminish as improved paints become less expensive and they and the surfaces they protect last longer.

REPRODUCE BUDDHIST TEMPLE IN PLASTER

AN ALMOST full-size reproduction of a great Buddhist temple at Angkor-Vat, Indo-China, was erected recently at the French Colonial Exhibition near Paris with the aid of plaster casts. They were taken directly from the original building, brought to France, and mounted on a framework at the exhibition grounds.

Angkor-Vat was built during the first half of the twelfth century after Christ. It is made entirely of sandstone. Every part of its surface is covered with stone figures.

TOASTERS ARE TOO HOT

COOKING experts in England declared recently that electric toasters cannot make good toast because they are too hot and work too fast, resulting in a slice of bread slightly browned outside and still somewhat moist within. They suggest that electrical appliance manufacturers should design electric toasters to work more slowly, even at the expense of a greater use of current.

A definite program for getting ahead financially will be found on page four of this issue.

TONY FOKKER CAPTURES AMERICA

(Continued from page 39)

beneath the wings of a monoplane. He kept the wireless crackling, sending detailed instructions to his Holland engineers for building the first tri-motored monoplane of history. Completed ahead of schedule, the unusual craft was rushed to America in time to compete in the first Ford Reliability Tour.

With three propellers pulling it through the air, the strange machine created a sensation. Drawing away from other competitors, it raced home the winner. But that was only the beginning of its adventures. Other victories lay ahead of those spinning propellers that have placed it among the handful of famous planes of history.

COMMANDER Richard E. Byrd, of the U. S. Navy, was looking for a plane in which to fly to the North Pole. He asked Fokker to sell the tri-motor. Because it was needed for demonstration purposes, the price was placed sky-high—$40,000. Undaunted, Byrd's backers wrote the check and the first three-engined ship became the *Josephine Ford*.

In it, Byrd and his pilot, Floyd Bennett, made their dramatic, fifteen-hour dash through crackling twenty-degree-below-zero winds over 1,200 miles of desolate, glittering ice from King's Bay, Spitzbergen, to the Pole and return, on May 9, 1926.

The gallant Virginian returned to America, the hero of the hour. He asked Fokker to build him a larger plane to cross the Atlantic. This ship, with its great seventy-foot wooden wing, was christened the *America*. When it was assembled at Teterboro Airport, N. J. Fokker climbed to the control wheel to test his latest craft. He had no idea that he was starting on one of the most exciting and dangerous hops of his career.

At the last moment, Byrd and his companions, Bennett and George O. Noville, asked to go along. The big ship, with main gas tanks empty, was slightly nose-heavy. The weight of the three passengers increased this tendency. In the air, the huge machine roared along under perfect control; but when it came coasting down to a landing it suddenly turned into a treacherous craft rushing to catastrophe.

It touched the field with tail high. Fokker, struggling to bring it down, had the wheel jammed against his chest. The relatively low landing speed made the elevators only partially effective. Instead of dropping, the tail continued to rise. With the nose swinging nearer and nearer to the ground, the huge craft "stumbled" across the field.

IT WAS only a matter of seconds, Fokker knew, until nose and ground met. Then the framework would telescope back, the engine crash in upon them, and it would be the finish.

Instead, the unexpected happened. The center propeller struck the ground at an angle, pushing the motor to the right. The fact that this fate-guided wooden blade struck at one point in its spinning circle instead of at another was the thread upon which the lives of four men hung.

The heavy machine, with crushed nose, somersaulted and crashed on its back with a terrific smash. Hot oil from a broken tank streamed over the pilot's compartment. Fokker fell head first to the ground. The others were pulled out, Bennett with a broken leg, Byrd with a broken arm, Noville with painful injuries.

The luck of the Flying Dutchman had held. Although the outline of the broken steering wheel was imprinted on his abdomen, he escaped with nothing more serious than bruises. The next *(Continued on page 132)*

TONY FOKKER CAPTURES AMERICA

(Continued from page 131)

day, he was at his factory directing repairs on the damaged ship, rushing to get it in the air again so the flyers could lead in the race to Paris.

Already, Clarence Chamberlin was tuning up his Bellanca for the flight; Noel Davis had been killed testing a big plane for the race; the French ace, Rene Fonck, had piled up in "Death Gulch" at the end of the Roosevelt Field runway; and rumors had crossed the country of the activities, in San Diego, of a St. Louis air mail pilot, "Slim" Lindbergh.

AS SOON as the *America* was repaired, Fokker took it up alone and put it through its paces. The ship was ready. But innumerable delays in preparation followed. Then, one afternoon, a small silver monoplane burst out of the western sky. It slid to a landing near the *America's* hangar, and the smiling, boyish figure of Lindbergh stepped from the cockpit. He had crossed the continent in two hops. He was ready for the jump to Paris.

Fokker was the last person to have a long talk with Lindbergh before the flight. While mechanics were filling the tanks, they discussed the preparations that had been made. As soon as the graceful *Spirit of St. Louis* was poised on the mound at the top of the runway, Fokker leaped to the wheel of his Lancia car and raced to the far end of the field, at the brink of the gully. His machine was filled with fire fighting equipment to use in case the Ryan monoplane could not get into the air with its big load of precious gasoline.

The heavy ship came roaring down the soggy runway, flame spitting from the exhausts of the Whirlwind. The wheels seemed glued to the ground. Five hundred feet from the gulch, it still hugged the earth. Three times, Fokker saw the young pilot try to lift the heavy plane. Twice he failed.

The third time, the loggy ship dragged itself off the ground with laboring engine. It barely cleared a tractor; just missed a telephone pole. Then the silver monoplane faded into the gray dawn. Lindbergh was off on the wings of destiny.

A fact that is little known is that Lindbergh originally asked the Fokker factory to build him a plane for the ocean flight. The sales manager turned him down because of rush business. Fokker heard of this, when it was too late, and realized the joke was on him.

MANY days later, the crew of the ill-fated *America* hopped off in the rain with only a handful of people to see them. They ran into fog and bad weather; flew blind over Paris and wandered, lost, groping through the wet mist over France. With the iron-nerved Bernt Balchen, who had replaced the injured Bennett, at the wheel, they headed back for the coast, plowing through the black night. Whipped by storms, the big Fokker rode the elements like a Viking ship with a Viking at the helm. Near Ver-Sur-Mer, Balchen brought them down, ripping through shallow water, crashing to a stop, miraculously alive.

While this saga of heroism on wings was being enacted, other Fokker ships were also making aerial history. The designer had the remarkable experience, in 1927, of watching the entire world, within the space of forty-eight hours, almost completely circumnavigated by Fokker planes.

Byrd and his crew were spanning the Atlantic; the Army flyers L. G. Maitland and A. F. Hegenberger were flying 2,400 miles over the Pacific on the first aerial journey from America to Hawaii; and Van Lear Black, late Baltimore publisher, was winging his way, with two Dutch pilots, from Amsterdam to the Dutch East Indies, 8,000 miles away!

Three years later, almost to the day, Fokker welcomed Charles Kingsford-Smith and the veteran Fokker monoplane, the *Southern Cross*, when it swooped down at Roosevelt Field after circling the globe. This sturdy *"Santa Maria* of the skies" had been built for the Arctic expedition of Sir Hubert Wilkins in 1925; had crashed on the polar ice; been rebuilt by Kingsford-Smith and piloted by him on his globe-circling Odyssey. An Australian ace during the World War, Kingsford-Smith is slight, red-haired; suggests a copper wire surging with electrical current. Fokker picks him as the most skillful and courageous pilot in the world.

TODAY, after tracing sky-trails into blank places on the map and pioneering across tossing wastes of water and bleak stretches of wind-swept ice, Fokker's planes are establishing new reputations for reliability in many parts of the world, plowing back and forth over established air lines with the regularity of locomotives.

It was this characteristic of his machines that decided the General Motors Corporation, two years ago, to enter the aircraft field, acquiring the Fokker concern. It is now manufacturing the giant F-32, largest land plane in America, a huge Pullman of the air accommodating thirty-two passengers.

Another recent product of Fokker's brain has just been tested by the United States Army. It is an all-metal monoplane, flying 200 miles an hour, carrying ten bombs and spitting a hail of lead from a quartet of machine guns concealed in the main wing.

This latest mechanical bird of prey, armed like a cruiser, racing through the air like a cannon ball, may change war air tactics almost as much as did Fokker's early inventions above the Western Front.

Only twenty-three years have passed since little "Tony" Fokker sat in his father's Haarlem attic excitedly working levers nailed to an old kitchen chair—playing he was flying. In the swift passing of a score of years, he has seen wings fitted to mankind, and has played a leading part in the accomplishment. By sheer genius he has won his way to the peak among designers and year after year has held his place against all comers. Now, in the land where the Wrights began, he is producing his greatest work.

TINY MOVIE THEATERS NOW IN OPERATION

THE first of a projected chain of miniature motion picture theaters, latest style in public entertainment, recently opened in New York. With turnstiles at the door to permit entrance by dropping a coin, and a unique type of projection screen that removes the need for darkness, it seats only 150 persons. Others will accommodate up to 300. Such a tiny theater may be made from a converted store, and it can be operated at from one tenth to one half the cost of a standard sized theater.

The new style is made possible by the special type of translucent screen used, according to the New York firm promoting the idea. The projector is behind the screen instead of in front of it. This permits the audience to sit in a lighted room. Present plans call for the opening of many such theaters immediately. Programs ranging from only fifteen minutes to an hour are planned.

TRAIN ROBBERS ROUTED BY SCIENCE

(Continued from page 15)

long terms in Atlanta penitentiary because in robbing a shipment in interstate transit they had committed a Federal offense.

Silk was one of the great prizes luring car burglars ten years ago. In 1920 the value of the raw silk stolen from cars or stations of the New York Central was $426,965. During the last five or six years not a dollar's worth of silk has been lost by the road. This is in spite of the fact that a small bale of silk, easily carried by a man, is worth about $500 and there have been times when that value was $900. All this thievery was stopped completely by policing shipments of silk.

THERE were some bottles containing brilliantly colored powders standing on the desk of Chief Roosa when I was in his office recently.

"Are you going in for chemistry?" I asked him.

"No," he replied, "but sometimes chemistry helps us."

Then he explained about the bottles. A railroad with scores of thousands of employees and with many other thousands of persons, messengers, truckmen, and other visitors having access to its premises, may suffer from sneak thieves. Sometimes they take baggage; sometimes they rifle desks.

The sum of their activities if uncontrolled might make a serious dent in the income of a railroad. Consequently such characters must be frightened into good behavior. The railroad has not the time to reform all the pilferers in the world. It has to be satisfied to keep them from stealing.

"Our method," explained the chief, "is quite simple. We always catch them.

"If we get a few complaints about objects disappearing from baggage, and everything that vanishes even though it is worth only a few cents is reported to us, we get busy with those little bottles. We place some of the powders in those bottles in the desks that are being looted; or rub it on baggage placed as bait.

"Usually the thief is not a very daring person anyway but what nerve he has vanishes when he discovers that his fingers have become stained with indelible marks that will not wash off, scrub them as hard as he may. Then along strolls a railroad policeman. All he is looking for is someone with stains on his fingers. Usually a thief trapped in that manner hasn't enough nerve left to lie about the matter."

Record keeping can be a science, and the localizing records of the New York Central police are certainly kept in a scientific manner. Sometimes the property of passengers disappears from coaches or Pullmans. The missing articles are catalogued in two ways by a sort of cross indexing that may be reached through a reference to the type of article or the place on the train where the happening occurred.

IT would not be fair to say too much about this system, but one illustration will serve to show its effectiveness. Several passengers on trains running in and out of New York had reported that their money had been stolen while they were sleeping in their berths.

The robberies were not confined to the same Pullman nor even to the same train. Nevertheless the records in Chief Roosa's office indicated that a certain colored porter might be responsible. It was revealed by those records that he had been aboard every train on which a robbery had occurred. Sometimes he had been the porter of a car in that train, but *(Continued on page 135)*

INSECTS AS TOOLMAKERS

(Continued from page 55)

mosquito's saw-and-lance skin-puncturing and blood-sucking equipment, the spider's teeth, and other insect tools for punching holes in things, you will find instruments more perfectly formed than any products of human skill. We think of a thing as being needle-sharp, but the stinger of a honey bee makes a needle look as blunt as a freight car.

It is not only as the possessor of a perfect needle that a wasp or bee or spider deserves fame, but as a skilled user of anesthetics. If physicians centuries ago had studied the hairy ammophilae wasp closely, thousands of human lives and a staggering amount of suffering might have been saved through the earlier development of anesthetics.

THIS particular wasp selects, as food for her family, a certain striped caterpillar. It finds it desirable to collect several of these, but wants the meat to be fresh. That means it must not kill the caterpillar, so it puts him to sleep or perhaps paralyzes him. In doing this, it has been credited with skill in using the hypodermic needle. Some observers claim that the wasp selects a spot on the caterpillar's back between the fifth and sixth rings, and makes an accurate stab at that point. The anesthetic enters a nerve center and partly paralyzes the caterpillar. To render it wholly helpless, the needle may be inserted several times at different spots.

The spider also administers anesthetics, and when he and the wasp meet the spider wins by striking the first blow. The wasp usually stumbles into the spider's net, and the spider, rushing out, greets his visitor with a bite under the wings. The spider's teeth are hollow, like tiny hypodermic needles, and the poison he forces out through these paralyzes the wasp before the latter has time to use its stinger.

The trapdoor spider has an instinctive knowledge of spring hinges. Its home is a hole in the ground. This it lines with silk wall paper, and covers with a trapdoor. When waiting for prey, the spider has its door partly open, so that it can snap shut and imprison the victim. At other times the spider shuts its door, but when it goes away on a visit, it ties the door open with a silk cord.

The next time you watch a cat or dog digging a flea out of its fur coat, think of a garden rake. The flea has a highly efficient rake attached to its head. This consists of a row of fine, slightly curved spines that enable the flea to scrape food particles from the epidermis of its host.

The mouth parts of other insects are as varied as the insects themselves. The tomato sphinx, a moth, has a tongue four inches long, two or three times the length of its body. It uses this tool almost solely for the purpose of long-range food gathering, reaching to the bottom of the Jimson weed flower for nectar.

In spite of the fact that scientists have been studying insects for a good many years, they are puzzled at many discoveries they have made. The elephant beetle, heavyweight champion of Insectdom, has a set of queer-looking horns that, although they are used some in combat, seem to be about as useful otherwise as the fifth wheel of a coach. The hercules beetle likewise has a nose and jaw that seem to be more than adequate for self-defense. Perhaps the idea here is to scare enemies by grotesque appearance.

The lantern fly, sometimes called the peanut bug, takes the prize for outlandish noses. It carries, sticking out ahead, an attachment that looks for all the world like a peanut, and is about the size of an average specimen. This "peanut" is hollow, and was formerly believed to be luminous. The eyes, directly behind it, are almost at the center of the insect's body.

Ask any insect authority what the real purpose of the peanut-nose is, and he more than likely will shrug his shoulders. Some of the lantern flies also provide another puzzle. They are manufacturing chemists that produce large masses of wax, sometimes two or three times the size of their bodies. In China, this wax has been used for making candles, but its usefulness to the fly is not clear.

THE paper on which this is printed is an insect invention. Unknown ages ago, some of the wasps learned how to make excellent paper from wood fibers, just as wood-pulp paper is made today. The social wasp gathers a mouthful of wood fiber, mixes it with a fluid from its mouth, and applies it to the nest, finally licking it with its tongue in order to brush on a waterproof glazing. Because some of the nest builders gather one kind of wood, and the others another, the nest may have a varicolored appearance. There is another wasp that manufactures cardboard in the same manner, letting the sun bake it on the walls of its home.

In protective adaptation or the science of camouflage, developed so highly by man during the World War, insects long have been supreme. Many small creatures depend for their safety on their resemblance to a twig, a leaf, a flower, the head of a poisonous snake, another insect or animal, or on the earth itself. Perhaps one of the noteworthy instances of deception is provided by certain moths that have noticeable spots or targets at the outer extremities of their wings. A bird, seeing these spots, may dive at them, thinking them some kind of food. If the attacker's aim is true—and it is, as a rule—the moth's wing may be torn, but its body remains intact.

Insects are credited with some subtle form of communication. A queen bee dies in a hive, and immediately the entire city of several hundred thousand individuals knows it. Something happens in a highly organized ant colony, and the news at once is mysteriously broadcast. A maiden oak eggar, a moth, decides that she wants a husband. She may be confined inside a building in the heart of a city, yet eligible males will flock from all directions simultaneously, coming great distances, in order to woo her.

HOW does all this happen? No one knows, but it is believed that a sense of smell plays an important part.

Insects also have an instinct for engineering and architecture. Spiders have been known to raise into the air small snakes and rodents by the application of a fundamental engineering principle. They ensnare the unfortunate animal in a silken net, then proceed to install numerous silk cords between the captive and an overhanging branch. By putting each of these lines under a slight tension one at a time, soon the point is reached where they all will act together to raise the captive off the ground. The process is repeated until the desired elevation has been obtained.

We know surprisingly little about the insect world. By studying the forms and activities of these tiny creatures we may devise new instruments for human use. Insects can produce cold light, yet we still waste most of our illumination in the form of heat. That is one promising field for investigation.

TRAIN ROBBERS ROUTED BY SCIENCE

(Continued from page 133)

the robberies never occurred in his car. At other times he was a dead-head passenger. Finally he was dismissed. Then another robbery occurred.

A wealthy man woke up one morning and began to squawk because his trousers were missing. They were found beneath a berth farther down the car. The pockets were empty. The man said they had contained $115. One of Chief Roosa's men was aboard the train. He spotted the dismissed porter riding on the train as a passenger and took him into custody. The man was carrying a revolver and that made it possible to arrest him. In his pockets $115 was found. New bills, unwrinkled.

THE colored man protested with heat that it was his money. While he was serving out a six-month sentence for carrying a revolver without a license, the railroad policemen kept on investigating. They went to the bank of the man who had been robbed. The cashier remembered that this rich man was always cranky about getting new bills when he cashed a check.

The bank records revealed that the money had been paid from a bundle received from the Federal Reserve Bank. A check-up revealed that the serial numbers of the bills in that bundle had included the same serial numbers of the bills found in the colored man's pocket. In the face of that evidence he decided to confess.

It is in that painstaking investigation and preparation of evidence that you can find a portion of the answer to the question as to how the New York Central with its property spread over half the continent has been able in the last few years to protect that property against thieves. It has protected it and is protecting it while all the cities through which the lines of the New York Central run have been suffering as never before from the depredations of thieves. Science has helped; so has the freedom of the railroad's police from the interference of gang politics; likewise marksmanship.

There have been plenty of gun fights in the last dozen years but now that it is pretty generally known that the railroad policemen have become crack shots there is less and less necessity for shooting. The pistol expert who teaches these men, traveling all over the lines to do so, is Captain Jack Smith, who formerly worked with Annie Oakley and traveled as an expert shot with the 101 Ranch Show.

It is not uncommon for communities along the New York Central to appeal for the aid of one of the company's crime specialists in emergencies. All of them are officers of the states in which they operate.

LIEUTENANT Joseph Genova of this unusual force of industrial policemen is so accomplished in tracking murderers that his services are often loaned to small towns bewildered by a mysterious crime.

One puzzling mystery solved after painstaking work by the New York Central men concerned a dynamite explosion at a mine tipple. A box of caps found at the scene of the explosion was traced to a place many miles away where dynamite had been stolen. The man who was arrested for the dynamiting had thought he had a pretty good alibi. At the moment the explosion occurred he had been talking to the local chief of police. How he arranged that was explained when it was revealed that with the dynamite he had taken 250 feet of fuse. While that was burning he had had ample opportunity to stroll into town and engage the chief in conversation.

Get In On Television

(Continued from page 17)

and swung open a door that covered a large thin metal disk painted dull black on both sides.

"I do after a fashion," I replied. "The microphone takes the voice or music vibrations and turns them into electrical vibrations and these are pumped up to pretty high intensity and then applied somehow to the carrier wave of the station. I'm afraid I couldn't explain just how that is done."

"YOU don't have to," he said. "You've got the main facts. Television, after all, is only piecemeal broadcasting. We really don't send pictures at all; only tiny little pieces of pictures one after the other. All the scanning disk does is to break up the picture into these tiny pieces so we can broadcast them. Do you see this row of holes in the disk?"

"You mean those small holes arranged in a spiral?" I asked.

"That's it," he replied. "Now what would those holes look like if you turned the disk very rapidly?"

"They wouldn't look like anything to me," I decided. "How could I see those tiny spots if the disk were spinning? They'd fly by so fast I couldn't follow them."

"Correct," he said. "Now watch closely." He turned a switch and the disk started to whirl. The spots representing the holes disappeared in the ordinary light of the studio. Then he held a drop light behind the disk.

"Now I see what you mean," I exclaimed. "The disk looks as if it were made with a band of gray glass where that spiral of holes is and I can see the electric bulb right through the disk."

"You only think you can," he laughed. "You could see only a tiny part of that bulb through any one hole in the disk or even through all the holes if they were in line instead of being spaced out around the disk in spiral form. Your eye fools you. Seeing through that disk is an optical illusion just as motion pictures are an optical illusion, and a television vision is an optical illusion.

"When light flashes into your eye," he explained, "the eye goes on thinking it sees light for over a thirtieth part of a second even if the flash only lasts for a thousandth of a second. The scientific sharps call that persistence of vision.

"Now, I'm going to turn on this big arc light back of the disk and put out all the lights in the room. Watch the wall there."

THE arc sizzled and then glowed brilliantly. Then the lights in the room went out and as he again started the disk, a row of tiny, brilliant light spots chased each other faster and faster across the blank wall. As the disk picked up speed, the light spots traveled so fast they became streaks. Because of their spiral arrangement, each one a bit closer to the center than the preceding one, these streaks overlapped and as far as my eyes could perceive, the rectangular section of the wall was uniformly lighted all over.

"I suppose you noticed," Mr. Higginbottom said, "that when the disk started up the rectangle was just wide enough to allow one spot of light to disappear at the edge of the rectangle at the instant the succeeding spot appeared at the opposite side. That means that there is actually only one spot of light in that entire rectangle at any one time.

"Now the amount of light reflected to your eye from the blank wall is steady because the draperies on the wall are all one color, but if you were sitting in front of it, the spot would reflect a lot of light when it struck your white collar and a lot less light as it passed over the neckband of your suit. Those photo-electric cells, which you see placed on either side of the piano in the studio, are affected by the amount of light reflected and are hooked into the broadcast transmitter in place of the microphone used in ordinary sound broadcasting. The result is that the radio wave carries a string of electrical pulsations equivalent to the variations in the one-after-the-other streaks of light."

"It's beginning to filter through my thick cranium," I interrupted. "By means of the traveling spots of light you get a piecemeal electrical picture that you can put on the air. Then all I have to do to receive that picture is make up some apparatus to reverse the process so I can turn the electrical impulses back into light that can be seen. Is that it?"

"YOU'VE got the right idea," Mr. Higginbottom replied. "In theory all you need is another disk like this one, a radio receiver, good audio amplifier, and a light that will flicker according to the electrical impulses. The neon light is the only one available to the amateur that will do the job."

"I'll buy one tomorrow and start making the disk," I said enthusiastically. "Then I'll hook it to my radio set and watch your next program."

"Go to it," he grinned. "Only remember that your radio set will do fine to bring in the sound accompaniment which goes out on a broadcast wave but it isn't a bit of use on the television signals. To begin with, it won't tune down to where the television signals are and besides, the audio amplifier in it isn't good enough.

"Television signals cover a much wider band of frequencies than broadcasting and you have to have a special, distortionless, wide-band audio amplifier. The television image isn't so good that you can afford to make it worse by using an unsuitable amplifier."

"Besides the special amplifier and short wave receiver, what other equipment will I need?" I asked.

"Of course," Mr. Higginbottom replied, "you will need a motor to drive the scanning disk and a neon lamp."

"How much do you think all of the equipment should cost me. That is," I added, "if I make and assemble some of the parts myself?"

"Let's see," he said. "If you buy all of the parts, it probably will amount to about $120, but if you hunt for bargains, assemble your own amplifier and short wave receiver, and make your own scanning disk you ought to be able to cut a third off that or maybe more."

"THAT'S a lot of money. What I am wondering," I asked hopefully, "is what kind of programs I am going to receive after I get the set built?"

"I think you'll like them. Our programs consist of musical numbers, vaudeville skits, speeches, and then, of course, interesting moving pictures with sound accompaniment."

"Moving pictures?" I asked. "I suppose you broadcast those by allowing the film to run through an ordinary moving picture projector and pick it up with a disk and photo-cell?"

"Partly right," he said, "but we don't stop the film a certain number of times a second as in the regular moving picture machine. It runs through continuously and the scanning disk has radial slots instead of holes. You see," he added, "the film runs by vertically and the slots in the scanning disk run by horizontally so that the combination of the two gives us the same effect we would get if we stopped the film twenty times a second and used a disk with holes accurately arranged in a spiral."

"What sort of pictures are you going to broadcast?" I asked.

"Just the same kind you see in a theater. Of course, they won't be brand-new feature pictures but I think you'll like them."

"How many television stations are now broadcasting in this country?"

"Well," he said, "on the last listing I saw there were twenty in all. Eight of these are located in New York, four in New Jersey, four in Illinois, and one each in Maryland, Indiana, Pennsylvania, and Massachusetts. Of these stations, eleven are operating on regular broadcast schedules."

"HOW about outdoor broadcasts?" I asked. "Have you been able to put outdoor scenes on the air yet?"

"In an experimental way, yes. Here," he said, pointing to a cameralike piece of apparatus, "is a television camera. Unlike the scanning mechanism used here in the studio this depends on the brilliant illumination of the subject for its operation."

"It has a disk just like the other, hasn't it?" I asked.

"Yes, it has a disk. The reflected light coming from the brightly illuminated object passes through the holes in the disk and scans a photo-electric cell housed at the rear of the camera," he explained.

"Oh, I see. The fact that the only light which reaches the cell is the spot of light reflected by the object allows you to use it out of doors," I said as the explanation struck home.

"That's right. Now, on the side of the housing is a control board," he continued. "The operator plugs in a pair of ear phones and by manipulating the various switches, controls the out-going signals as well as the sight."

"I guess next fall I'll be able to sit in my living room and enjoy a football game," I said enthusiastically.

"I doubt that," said the engineer. "This camera at the present time is just an experiment, and there are lots of difficulties that must be ironed out before we can use it with a fair degree of success."

"Football or no football," I said, "I am going down to the bank tomorrow and draw out some money and then shop around and see what I can pick up in the way of bargains in television equipment."

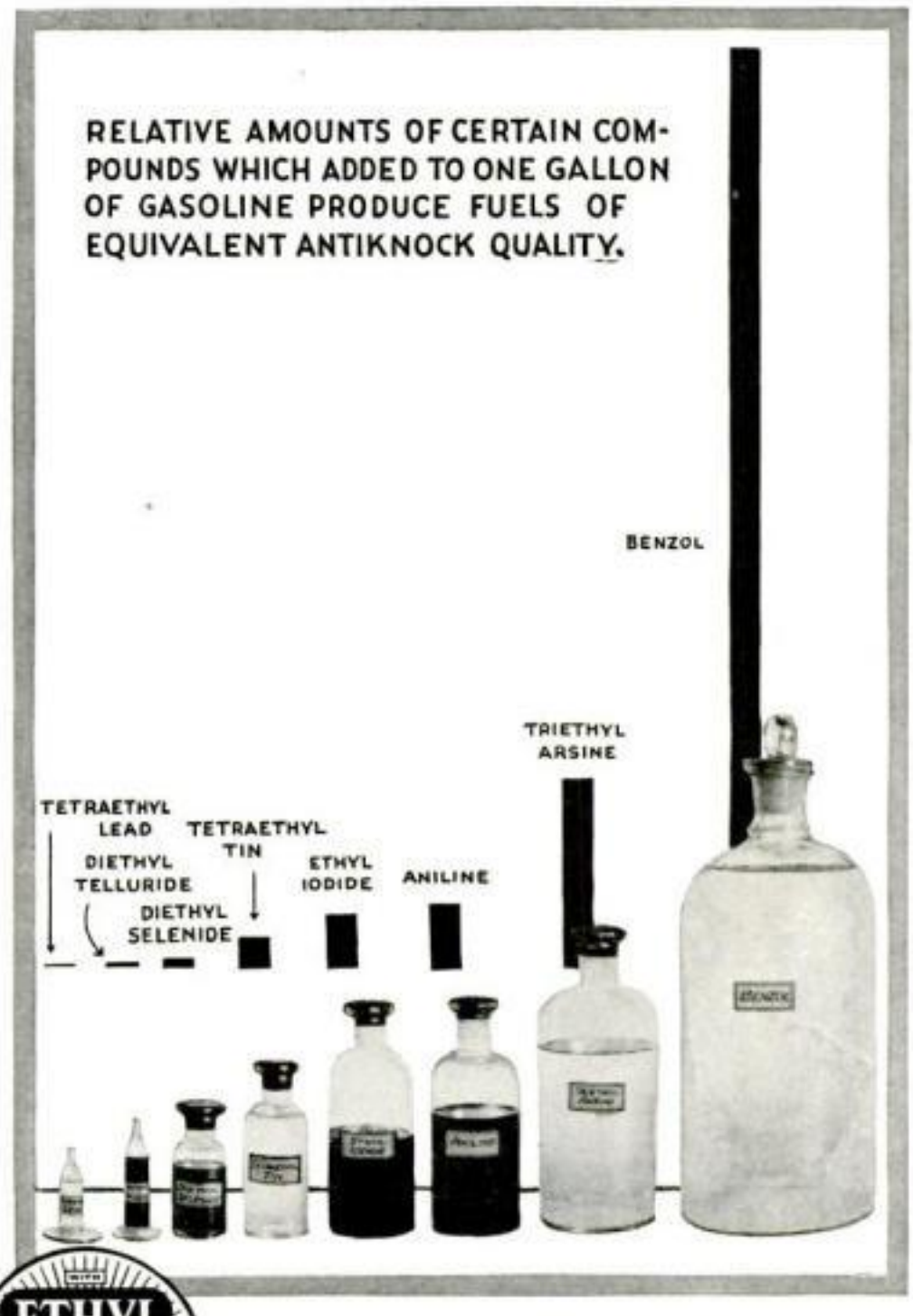
NEXT month you can go with George Waltz on his shopping tour, for television receiver parts and learn with him just what is available in separate parts and knock-down kits, what can be made and what must be bought, and how much it costs. If you follow along with him you can build a television receiver and share with him his thrill when he completes his set and tunes in his first television image.

OAK TREES TURN INTO LIVING GAS TORCHES

OAK trees that become living gas torches are a curiosity recently reported by two members of the Asheville, N. C., Forest Experiment Station. When they bored into the trunks of chestnut oak and white oak trees they were found to emit an inflammable gas. When a match was applied, a blue flame sometimes as long as two and a half feet shot from the hole. It burned at full force for about thirty seconds. The source of the gas was found to be decaying wood.

Ethyl is the *most practical* anti-knock ingredient known

Compare!



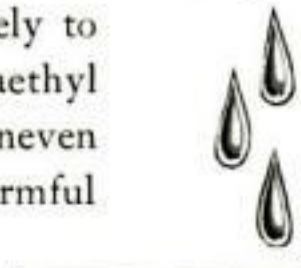
IT took seven years of testing and experimenting to produce Ethyl fluid. During that time, 33,000 chemical compounds were studied.

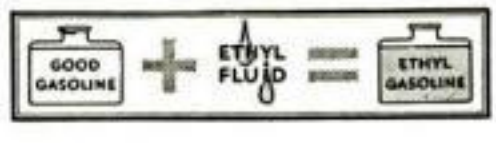
All the compounds shown in this picture have anti-knock qualities. None of them is nearly so practical as tetraethyl lead, which is the active ingredient in Ethyl fluid. Some are required in such large quantities that more than the total available world supply would be needed to treat all the gasoline requiring anti-knock. Others do not vaporize easily and completely.

Even tetraethyl lead cannot be used alone. It is mixed with other chemicals which combine with it at the time of combustion to form a gas that passes out of the cylinders.

The red dye which is in all Ethyl fluid has nothing whatever to do with its power to control combustion. The dye is added solely to give an identifying color. It is the tetraethyl lead in Ethyl fluid that prevents the uneven explosions that cause power-waste, harmful "knock" and overheating. It *controls combustion* so that power is delivered to the pistons with a smoothly increasing pressure that brings out the maximum performance of any car.

ETHYL — BRAND OF ANTI-KNOCK COMPOUND — ETHYL GASOLINE CORPORATION — Controls Combustion





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